MIDWAY AND KENT HIGHLANDS SANITARY LANDFILLS

DESCRIPTION OF ALTERNATIVES

FOR CLOSURE PLANS

Prepared for

City of Seattle
Solid Waste Utility

Prepared by

PARAMETRIX, INC.
13020 Northup Way, Suite 8
Bellevue, Washington 98005
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1. INTRODUCTION

1.1 PURPOSE AND SCOPE

The Solid Waste Utility of the Seattle Engineering Department operates sanitary landfills at Midway and Kent Highlands. Both sites are nearing their capacity and as of October 1, 1983, the Midway Landfill was essentially closed to refuse disposal. The City of Seattle has initiated development of landfill closure plans for each site to provide for an orderly phase out of operations and permanent closure. The City has conducted fairly detailed site hydrogeologic investigations, performed water quality and landfill gas testing, prepared current topographic maps for each site and reviewed land use and lease issues with respect to both sites. The City is now entering the environmental review process phase which will culminate in the preparation of a draft and final environmental impact statement for closure plans for the Midway and Kent Highlands Sanitary Landfills.

The purpose of this report is to describe in more detail those alternatives which could be utilized in developing a final closure plan for each site. In general, those alternatives focus on four key elements: final site grading, surface water management, leachate management and gas/odor control. In addition, to be consistent with the SEPA process, a "no project" alternative has also been described. Where appropriate, graphic interpretations of each alternative have been prepared and are included in this document.

This report also includes a description of the existing conditions at each of the two landfills. The alternatives described herein address only the engineering, geotechnical and hydrological aspects of a closure system and do not assess the extent of any existing or future contamination associated with the sites. Each alternative has been investigated in sufficient detail to demonstrate overall engineering feasibility and provide a sufficient quantitative description from which preliminary economic comparisons can be formulated. Depending on the impact assessment and required mitigative actions developed in the EIS, additional engineering analysis and requirements may be required prior to the actual preparation of detailed project plans and specifications.

1.2 REGULATORY REQUIREMENTS

Alternatives described in this report for the various elements of the closure plan are intended to satisfy the requirements of regulatory agencies concerning:

- Surface water management
- Leachate/groundwater management
- Methane gas management
- Final grade contours

The particular elements that are incorporated into the preferred alternative for the closure plans at the Midway and Kent Highlands landfills will depend on a number of factors, including regulatory requirements, final land use and cost. Regulatory requirements that will affect the closure plans for the landfills are presented below.

State and County regulatory requirements governing landfill operation and closure are outlined in State of Washington regulations relating to Minimum Functional Standards for Solid Waste Handling, WAC 173-301 and King County Board of Health Rules and Regulations Establishing Minimum Functional Standards for Solid Waste Handling; Prohibiting Certain Conduct, Number VIII. Applicable state and county requirements pertaining to closure of landfills are listed below.

- Provision shall be made for adequate venting or redirecting of gases generated by solid waste, if conditions require. It shall be the responsibility of the operator to develop a sampling and testing program to monitor gas production approved by the Seattle-King County Department of Public Health.

- As soon as possible after reaching the final lift of a given area of a site, the area shall be covered with an equivalent of two feet of compacted soil adequately sloped to allow surface water to run off.

- The finished surface of the filled area shall be covered with adequate tillable soil and seeded with native grasses or other suitable vegetation immediately upon completion, or as soon as conditions permit. If necessary, slopes shall be covered with straw or other mulch to prevent erosion, both before and after seeding. Final grades shall conform to those specified in the approved design plan. Proposed revisions of the original design plan shall be submitted to the Health Officer for approval.

- At the completion of the final cover of a sanitary landfill, the Seattle-King County Department of Public Health shall be notified at least 30 days in advance in order that a site investigation may be conducted before earth-moving equipment is removed from the property. Maintenance shall be conducted by the owner of this site at the time of the abandonment and/or completion until the fill becomes stabilized or for a minimum of ten years. Necessary leveling and repairs shall be made.

- Maps and a statement of fact concerning the disposal area shall be recorded as part of the deed with the County Department of Records and Elections not later than three months after the completion of operations. Records and plans specifying materials, location, and periods of operation shall be available for inspection. Areas used for the disposal of wastes shall not be sold or transferred without advanced notification of the Seattle-King County Department of Public Health.

Relatively few specific regulatory requirements pertain to groundwater monitoring at solid waste sites. Under RCRA, the EPA has published criteria in the Federal Register (FR) September 13, 1979 for classifying facilities as either sanitary landfills or open dumps. Groundwater criteria specify that "A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary . . ." The term "underground drinking water source" applies to any aquifer supplying drinking water for human consumption or any aquifer containing groundwater with less than 10,000 mg/l total dissolved solids. Under the latter definition the groundwater in the Midway and Kent Highlands areas would be considered a drinking water source.

The King County Health Department and the Washington Department of Ecology have enforcement power over the regulations. It is anticipated that these closure alternatives and the subsequent environmental review process will provide the basis from which these two agencies will issue final closure plan approval.

2. MIDWAY LANDFILL EXISTING CONDITIONS

2.1 SITE DESCRIPTION

The Midway Sanitary Landfill is a 60-acre site located at South 248th and Pacific Highway South, inside the City of Kent. The site has been operated by the Solid Waste Utility of the Seattle Engineering Department since January 1966 on property owned by Romano & Associates. Total capacity of the site was originally estimated at 4 million cubic yards. Approximately 3,000,000 tons of solid waste have been deposited at the site since operations began. The site has been operated to date according to a grading plan developed by the City shortly after operations first began. The existing site conditions are shown in Figure 2-1.

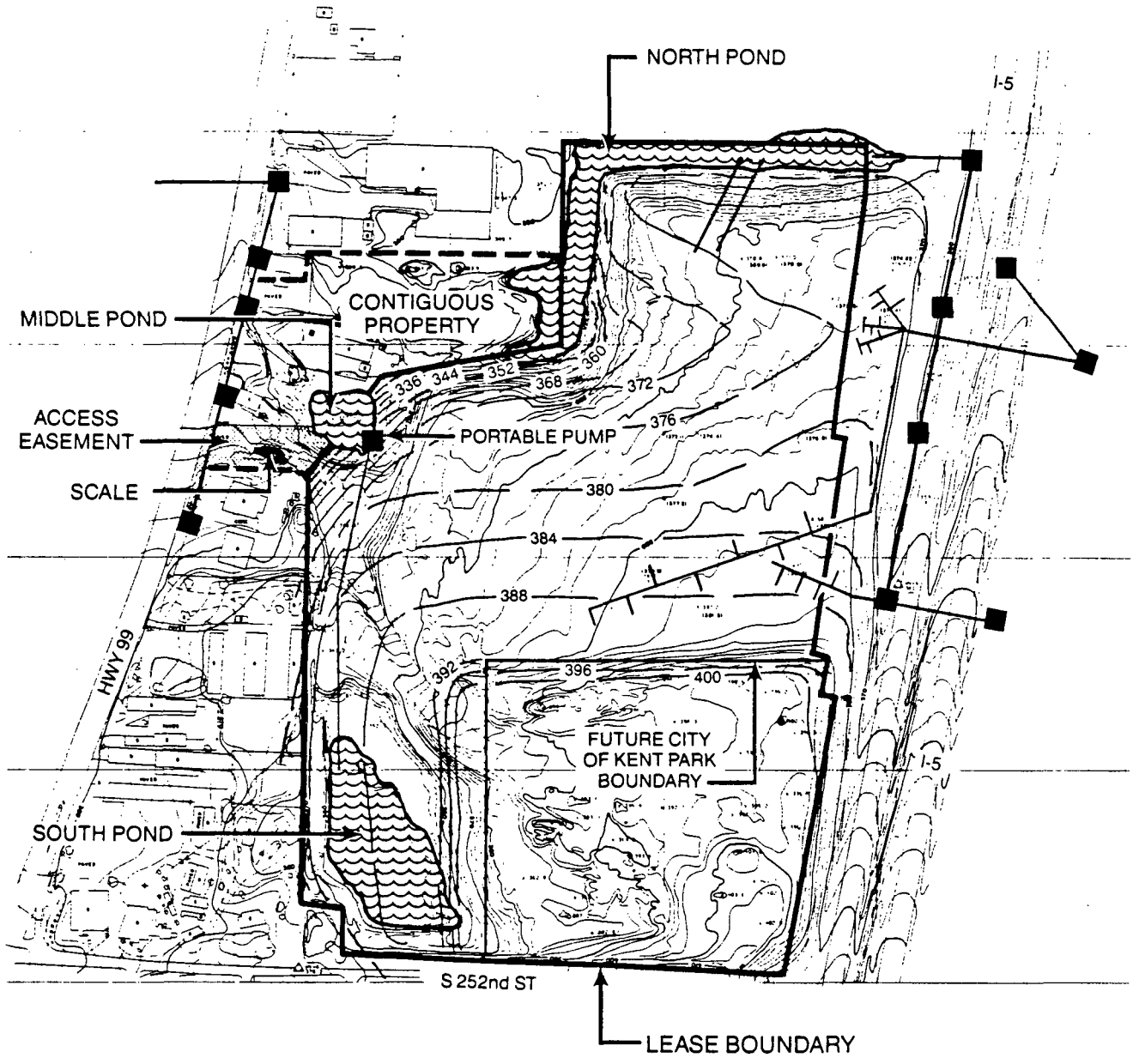
2.2 OPERATING STATUS

The site was initially operated as a non-putrescible landfill receiving primarily demolition and transfer station wastes. In June 1982, all transfer station loads were diverted to the Kent Highlands Landfill and overall delivered quantities were reduced to 4,200 tons per month. On October 1, 1983, the site was essentially closed. Only clean soil from excavation wastes are being accepted.

2.3 SITE GRADING

The majority of the site has been filled to near the proposed final grades included in the current grading plan. However, the southwest corner is still about 45 feet below the grade of the adjacent property and about 60 feet below the proposed final grades. This area is the South Pond, one of three ponds on the site.

At the southwest corner of the site, the vertical bank on the west side is sloughing off. Continued sloughing could move the vertical face west past the property line. Some dirt has been placed along the bank to help stabilize it, but the top portion of the bank remains unprotected.



Storm Water Inlet

Drain Field Line

Pond Water

Existing Drainage Lines

Current Grading Plan -- 350 --

0 200 400

SCALE IN FEET

N

Figure 2-1. Midway Landfill existing conditions.

2.4 SURFACE WATER MANAGEMENT

The topography surrounding the site, as well as the historical operation of the facility as a surface mining operation, has resulted in the Midway Landfill becoming a localized drainage sump. Surface runoff from the area surrounding the site is tributary to the landfill and is delivered either via overland flow or direct piped discharge. The principal contributing areas are the I-5 corridor directly east of the site and commercial/residential properties lying directly north of the landfill.

A portion of the I-5 corridor is piped directly into the landfill via a culvert crossing beneath the freeway. The majority of the remaining tributary areas discharge to the north end of the landfill.

There is no physical outlet for surface water within the site and runoff from off-site areas, as well as precipitation received within the landfill, tend to accumulate in localized depressions. Currently these depressions are termed the North Pond, Middle Pond and South Pond. A leased tank truck is used to haul liquids from the Midway Landfill to the Kent Highlands Landfill where clean stormwater is discharged into the stormwater system and water containing leachate is discharged into the leachate treatment system for pretreatment prior to being pumped to the Metro sewer system.

2.4.1 North Pond

The North Pond is contiguous to the north property line and is adjacent to the north face of the fill. It extends around the northwest corner to the south. The North Pond collects the stormwater runoff entering the site via a pipe under I-5. Water in this pond is essentially surface runoff. The rented tanker is used to haul the North Pond liquid for disposal as stormwater and/or leachate at Kent Highlands Landfill.

2.4.2 Middle Pond

The Middle Pond collects site surface runoff, North Pond overflow, and possibly leachate seeps from the landfill. The pond lies between the west side of the fill and Highway 99 and was created primarily because of the failure of the dam on the North Pond. This area essentially flooded to a depth of 8 to 10 feet. Both water and mud have been hauled out of the Middle Pond and the pond has stabilized at about 3' in depth with a surface area of about 2,500 square feet. The area flooded last winter surrounding the Middle Pond has been sloped to the pond to increase control of any water entering this area.

2.4.3 South Pond

The South Pond is located in an unfilled area at the southwest corner of the site. This is a relatively isolated area and the pond primarily receives surface runoff from onsite areas, as well as leachate seeps. This accumulation of surface runoff and leachate did cause problems in the spring of 1983. Complaints were received concerning offensive odors and the Solid Waste Utility responded by initially aerating the pond and followed this by pumping the liquid into a tanker truck for disposal at the Metro wastewater treatment plant at Renton. The pond was pumped dry by the summer of 1983.

2.5 LEACHATE MANAGEMENT

There are no formal leachate collection facilities at the Midway Landfill. Leachate seeps are generated at the periphery of the site currently and tend to migrate to the existing ponds where they combine with accumulated surface drainage. This combination of leachate and surface water is removed from the ponds via tanker truck for delivery to the Kent Highlands Landfill leachate treatment facility for pretreatment and discharge to the Metro sewer system. Leachate also accumulates in the perforated pipe recently installed as part of the gas collection trench along the south and west side of the landfill. This leachate is pumped out and also hauled to the Kent Highlands Landfill for disposal in the leachate treatment system.

In the summer of 1983 a clay liner was installed in the South Pond, but the landfill and the two other ponds are unlined; therefore, vertical leachate migration from the site is a definite potential. A preliminary groundwater monitoring program indicates that leachate is being generated and is migrating off-site in a south and westerly direction.

2.6 GAS/ODOR CONTROL

Landfill gas is being generated at the Midway Landfill in sufficient quantities to produce on-site odors, as well as differential pressures causing lateral offsite migration. A monitoring program conducted in 1982 by the Health Department and continued by the Solid Waste Utility, has detected offsite methane concentrations on the east side of Highway 99. Onsite escapement of landfill gas has caused noticeable odors since the 1970's. Diffusion through the soil cover, as well as point source discharges through soil fissures, are the principal sources. The actual detected odor is not the methane gas, but other trace compounds, such as hydrogen sulfide and various odorous volatiles, contained in the landfill gas.

The City's control program for landfill gas has primarily utilized ground flares connected to gravel packed, passive vent wells. This thermal oxidation technique has proved reasonably effective at other similar landfills; however, the fact that odors still persist at Midway makes it somewhat difficult to assess the effectiveness at this site.

Until the summer of 1982, no specific attempts had been made to prevent lateral migration of landfill gas. After conclusive detection of offsite migration, the City began installation of a peripheral venting trench along the south and westerly boundary of the fill. This gravel filled trench will be carried the full height of the landfill to provide for interception and atmospheric venting of gases. The vents are equipped with burners for flaring off the gas.

2.7 LEASE AGREEMENT CONDITIONS

The current lease and easement agreement for the Midway Landfill between the City of Seattle (operator) and Romano & Associates (owner) was made on October 29, 1981. The agreement contains certain terms, covenants and conditions that could possibly affect the alternative closure plans for the site. The pertinent conditions are discussed below.

2.7.1 Filling of Contiguous Property

Paragraph 8 of the October 29, 1981 agreement states that the operator will utilize salvaged material from street work and other acceptable sources to the greatest extent possible, to fill the contiguous property shown on Exhibit "A" attached to the agreement, to raise the elevation of the contiguous property equal to the elevation of the centerline of Old Highway 99 which runs along the westerly line of the contiguous property. (This property lies near the northwest corner of the landfill.) The agreement states that the final two feet of the fill shall not contain rubble in excess of one foot in the greatest dimension.

2.7.2 Final Cover

Item d. of Paragraph 9 of the agreement states that the final cover material, including the type of material used, shall be determined by an engineering study to be made by or for the operator. The methods and materials to be used shall be submitted to the owner for comments. The operator shall, to the extent possible, incorporate the owners' desires into the completed cover plan.

Item p. of Paragraph 9 states that the final cover shall be two feet deep.

2.7.3 Methane Recovery

Paragraph 11 of the agreement states that both parties agree to cooperate in any investigations by either party into the recovery of methane gas from decomposition of material placed in the fill, and if methane recovery appears to be feasible on a commercial basis, both parties shall meet with the intent to develop appropriate agreements as to rights and responsibilities for a long term recovery system.

2.7.4 City of Kent Park Site

Paragraph 12 of the agreement reaffirms the terms and conditions of that certain "Amended Agreement" dated May 11, 1966 with the City of Kent concerning dedicating by the owner, and filling and landscaping by the operator of a portion of the leased area. Exhibit "A" of the agreement shows the City of Kent park site to be approximately the easterly three-quarters of the southerly half of the site.

2.8 LAND USE ISSUES

The current land use of the Midway Landfill site is designated as general commercial with a mixture of commercial manufacturing and industrial zones along Highway 99 and a mobile home park zone to the north of the landfill and a single-family residence to the south across from South 252nd Street. The proposed land use for the Midway Landfill site according to the zoning plan being developed is to be zoned multi-family dwellings, except for the City of Kent park site in the southeast corner of the landfill site.

3. MIDWAY ALTERNATIVES

3.1 SITE GRADING PLAN

Alternative site grading plans for the Midway Landfill have been conceived with the intent of controlling surface water infiltration and to provide stability of the fill and adjacent properties. Accordingly, a four percent minimum slope was selected to facilitate runoff and a maximum slope of four horizontal to one vertical was used for the fill slopes. These slopes may conflict with the intended final land use, but grades must be designed to permit drainage during the settlement of the fill which may be as great as 15 percent. Continual maintenance of the surface grades may be necessary during the first 5 to 10 years after closure, and some regrading may be required after the fill has stabilized to accommodate the intended final use.

3.1.1 Maximum Grade Alternative

This alternative, shown in Figure 3-1, is intended to optimize the onsite drainage regardless of proposed land use development. Accordingly, the final grades of the landfill have been raised, particularly in the southeast corner. The maximum grade alternative will require an estimated 935,000 cubic yards of material (plus final cover) to bring the site up to the final grade from its existing condition. The Midway site was recently closed to all material except clean soil from excavation wastes and this material comes into the site at a low rate. In order for the site to close in a reasonably short time (2-3 years, based on the rate which refuse previously was delivered to Midway), a large source of material would have to be located and the rate of filling would have to be substantially increased. Therefore, unless a low or no-cost source of fill material such as excavation from the Mt. Baker tunnel can be secured, this alternative may be economically unfeasible without reopening the landfill to non-putrescible refuse.

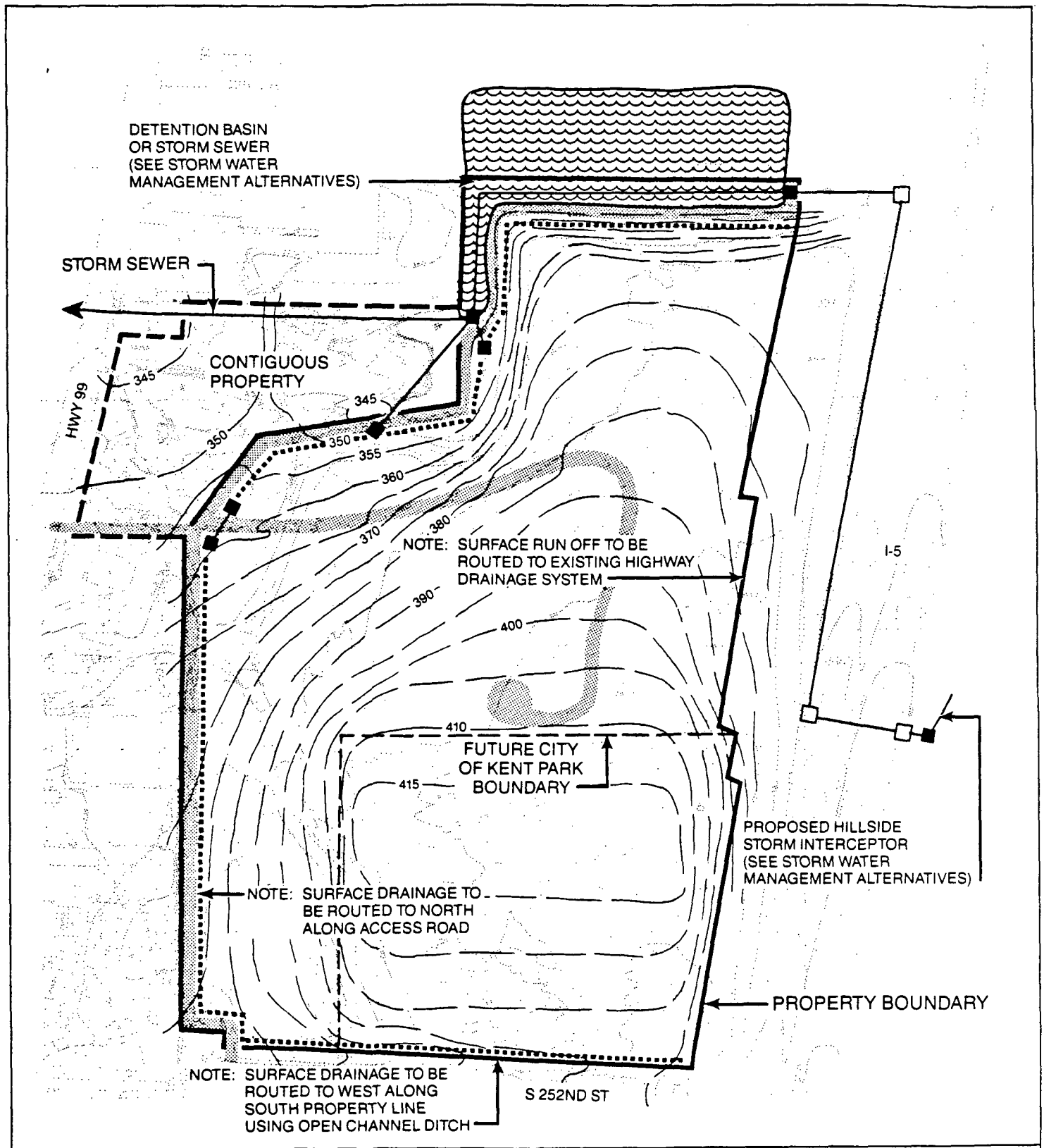


Figure 3-1. Midway Landfill maximum grade alternative.

The on-site drainage system included with this alternative directs surface water runoff to the west and north sides of the landfill. This will require a drainage swale along the westerly boundary sloping north to where an on-site detention basin would be located if one is included in the surface water management plan for the Midway Landfill. At the extreme south boundary of the site, a separate ditch discharging to the swale on the west side of the property would have to be provided to handle the small amount of surface water draining southward off the site. Alternatively, it may be possible to utilize the current roadway drainage system in So. 252nd Street to handle this drainage.

3.1.2 Intermediate Grade Alternative

Because of the large quantity of fill associated with the maximum grade alternative and the length of time required to complete the closure under that alternative, the intermediate grade alternative was developed to provide lower finished contours requiring less fill material and thereby allowing an earlier closure of the landfill. This alternative requires an estimated 310,000 cubic yards of fill (plus final cover) and would allow closure of the landfill in about 12 to 18 months, if material were brought in at the same rate as proposed in the maximum grade alternative. Because of the significantly lower fill volume than in the maximum grade alternative, this alternative may be economically feasible using clean fill material, but could also be accomplished by reopening the site and filling with non-putrescible refuse. The Intermediate Grade Alternative is shown in Figure 3-2.

The on-site drainage system for this alternative would be similar to that for the maximum grade alternative, except there would be very little if any surface runoff southwards from the site and any that did occur would be handled by the current drainage system along So. 252nd Street. As with the maximum grade alternative, an on-site detention basin, if included for surface water management, would be located at the north end of the site. However, it would also be possible, with minor grade revisions in the northwest corner, to relocate the basin southward along the west side of the site and allow all storm water facilities to be located within the current landfill property.

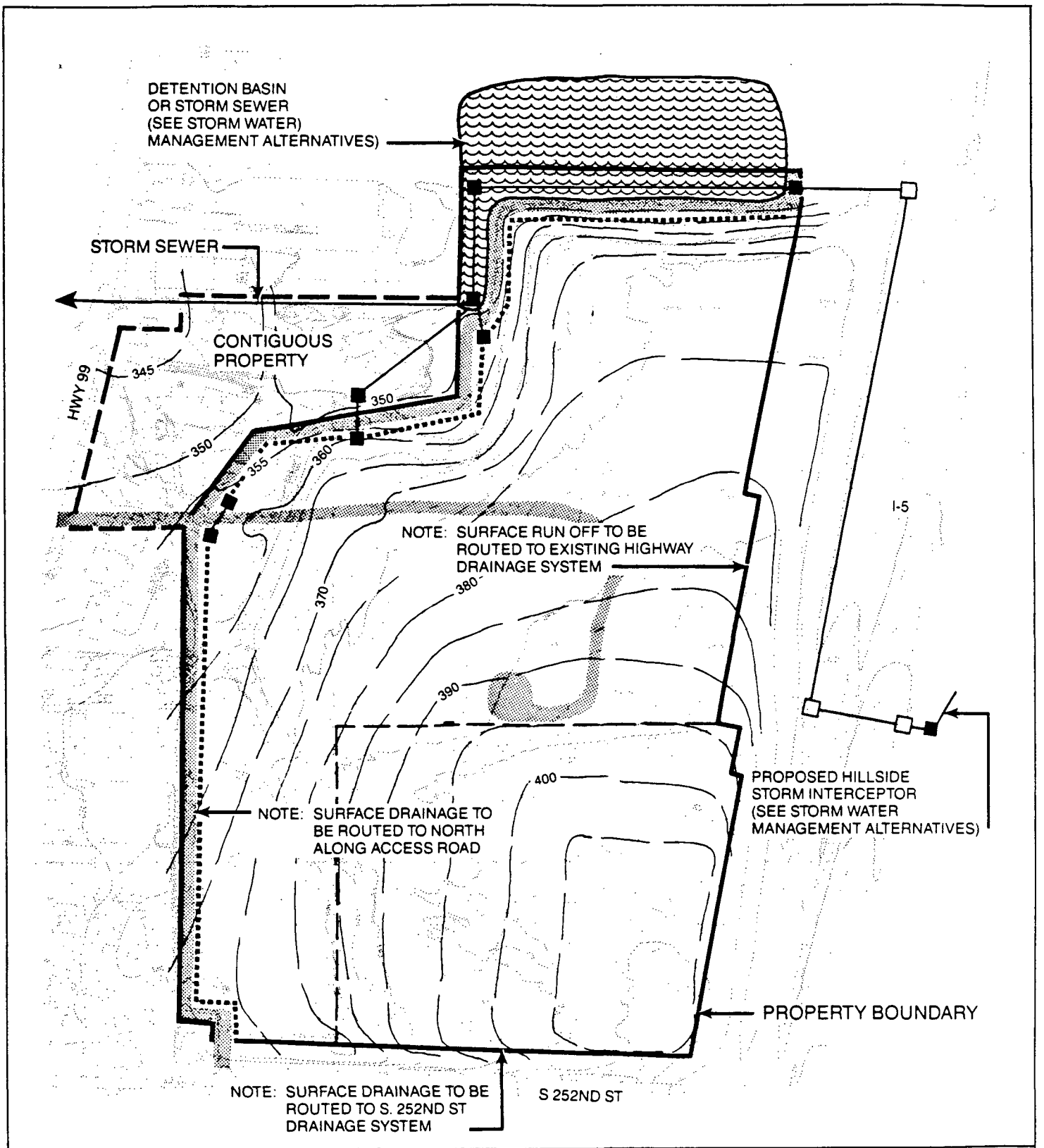


Figure 3-2. Midway Landfill intermediate grade alternative.

3.1.3 Minimum Grade Alternative

This alternative was conceived to represent the minimum amount of filling of the site required to improve existing drainage problems. The Minimum Grade Alternative is shown in Figure 3-3. To avoid pumping the surface water runoff, filling of the South and Middle Ponds is necessary with this alternative. Because of this, the alternative provides final grades similar to those of the intermediate grade alternative. In the minimum grade alternative, however, the only substantial filling would be in the South Pond so that surface water runoff would flow to the north. This requires about 40 to 50 feet of fill in the southwest corner of the site. The Middle Pond and the contiguous property would be filled about 10 to 20 feet so that surface water runoff would drain to the north. Additionally, the southeast corner of the site would be filled to provide the four percent minimum slope and promote surface water runoff in this corner. This alternative requires an estimated 150,000 cubic yards of material (plus final cover) to bring the site up to grade from the existing condition. With this volume, it is proposed that only clean fill material be used and the site would not be reopened to transfer station refuse.

The on-site drainage system for this alternative would also be similar to that of the intermediate grade alternative. Surface water runoff from the site would be directed to open channel drainage ditches along the south and west sides of the landfill. From there the water would flow to the north end of the site where an on-site detention basin, if included for surface water management, would be located.

3.2 SURFACE WATER MANAGEMENT PLAN

Alternatives for control of on-site surface water are included with the alternative grading plans previously discussed. Alternatives for off-site surface water management include discharge to Puget Sound or the Green River, with detention either on or off the site or no detention at all. Control of the surface water runoff is one of the most important elements in the closure of the landfill because the success of all other elements will be at least somewhat dependent on the effectiveness of the surface water management plan. For the Midway Landfill alternative surface water management plans are intended to be capable of handling the 25-year design storm. In addition to the facilities discussed below, each alternative would include a surface water monitoring program to monitor all surface waters at the location where they discharge from the site.

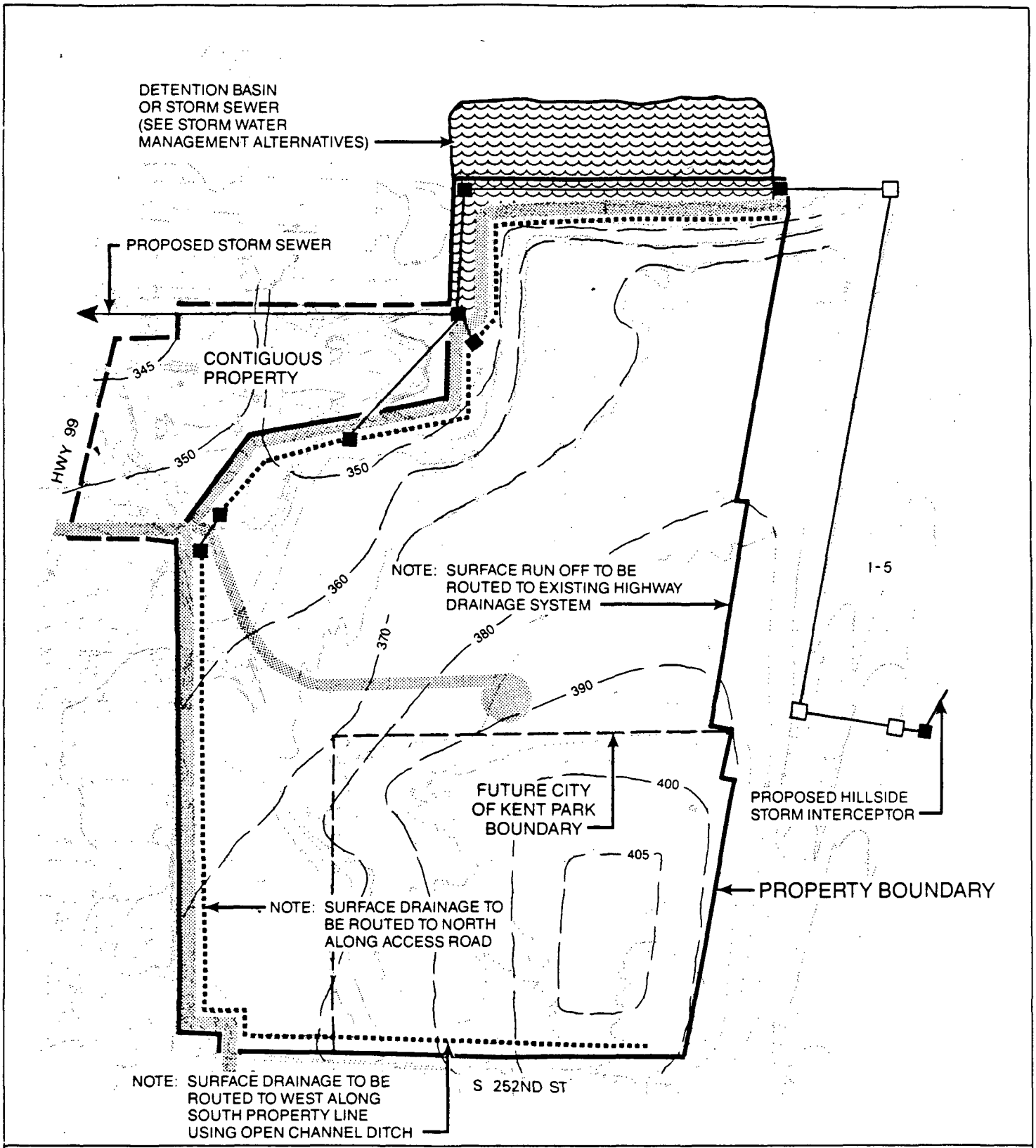


Figure 3-3. Midway Landfill minimum grade alternative.

3.2.1 Puget Sound Discharge Alternative With Off-Site Detention Near Parkside Elementary School

This drainage alternative, shown in Figure 3-4, collects all the surface water runoff from east of the landfill site and routes it around the periphery of the landfill to the northwest corner. At this point, the system picks up the on-site surface water runoff and routes it under Highway 99 in a closed pipe system to an existing natural detention basin at the southeast corner of the Parkside Elementary School site. The existing natural basin would be enlarged and converted to a formal detention basin with a controlled outlet structure with discharge through existing drainage facilities leading eventually to Puget Sound. Because some of the facilities downstream of the detention basin are already undersized, some minor improvements downstream of the detention basin would be required.

3.2.2 Puget Sound Discharge Alternative With On-Site Detention

With this alternative, all detention facilities would be provided at the landfill site and a pipeline would be provided under Highway 99 to the natural detention basin near Parkside Elementary School. However, this basin would remain in a natural state and flows to it would be controlled so that they are equal or less than the existing flows. In order to accomplish this, it is necessary to divert the drainage from the east side of Highway 99 into the on-site detention basin. Surface water runoff from east of the landfill, as well as the on-site runoff, will also be directed to the on-site detention basin. This will require a fairly large basin and it is anticipated that encroachment onto properties north of the landfill may be required. However, it may be possible to keep this basin entirely on the landfill site by revising the grades and excavating some of the existing landfill material. The detention basin will be adjacent to the landfill and to reduce the possibilities of leachate contamination of the basin, a containment dike would be constructed along the north end of the landfill. This alternative is shown in Figure 3-5.

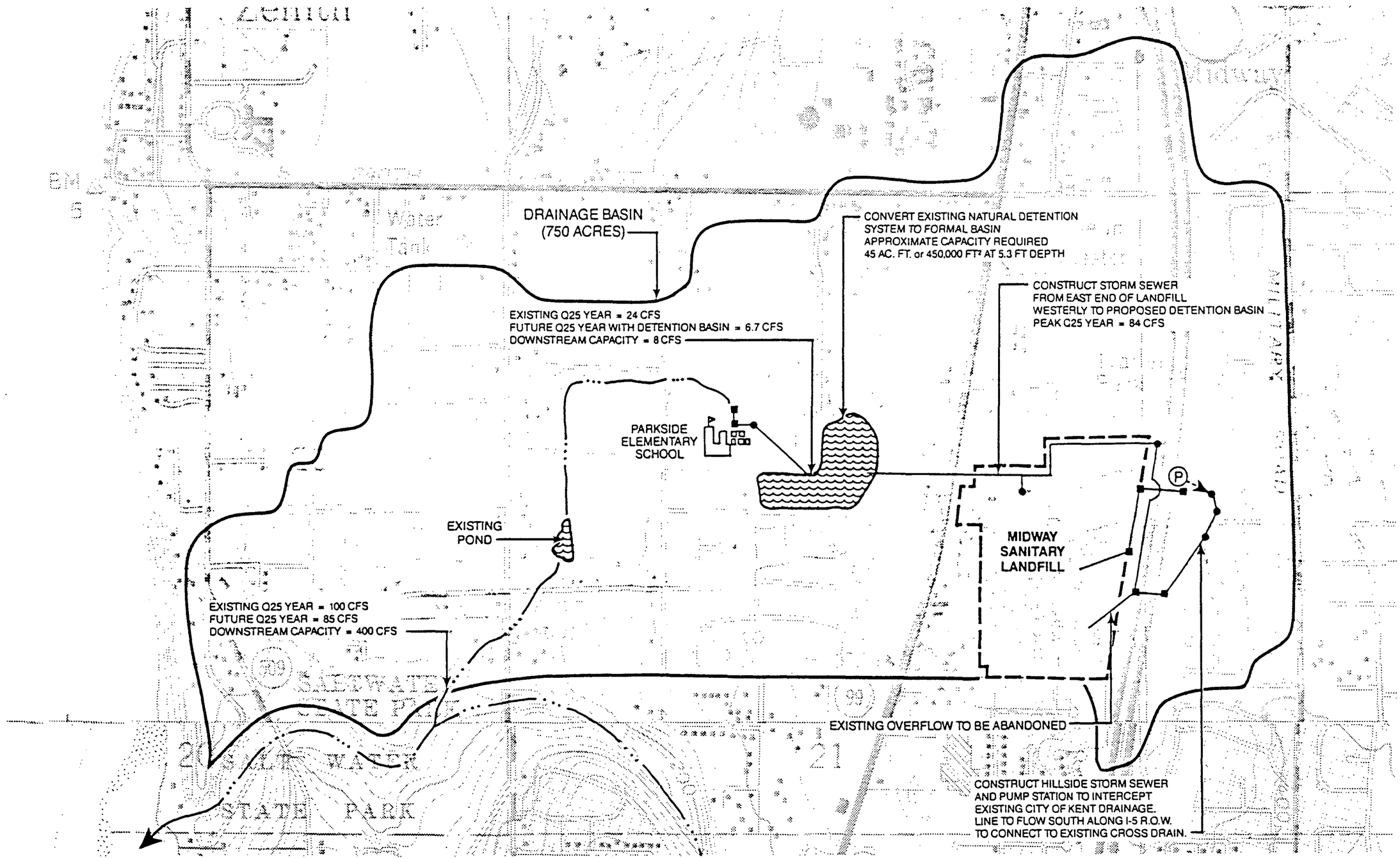


Figure 3-4. Midway Landfill drainage Puget Sound discharge alternative off-site detention near Parkside Elementary School.

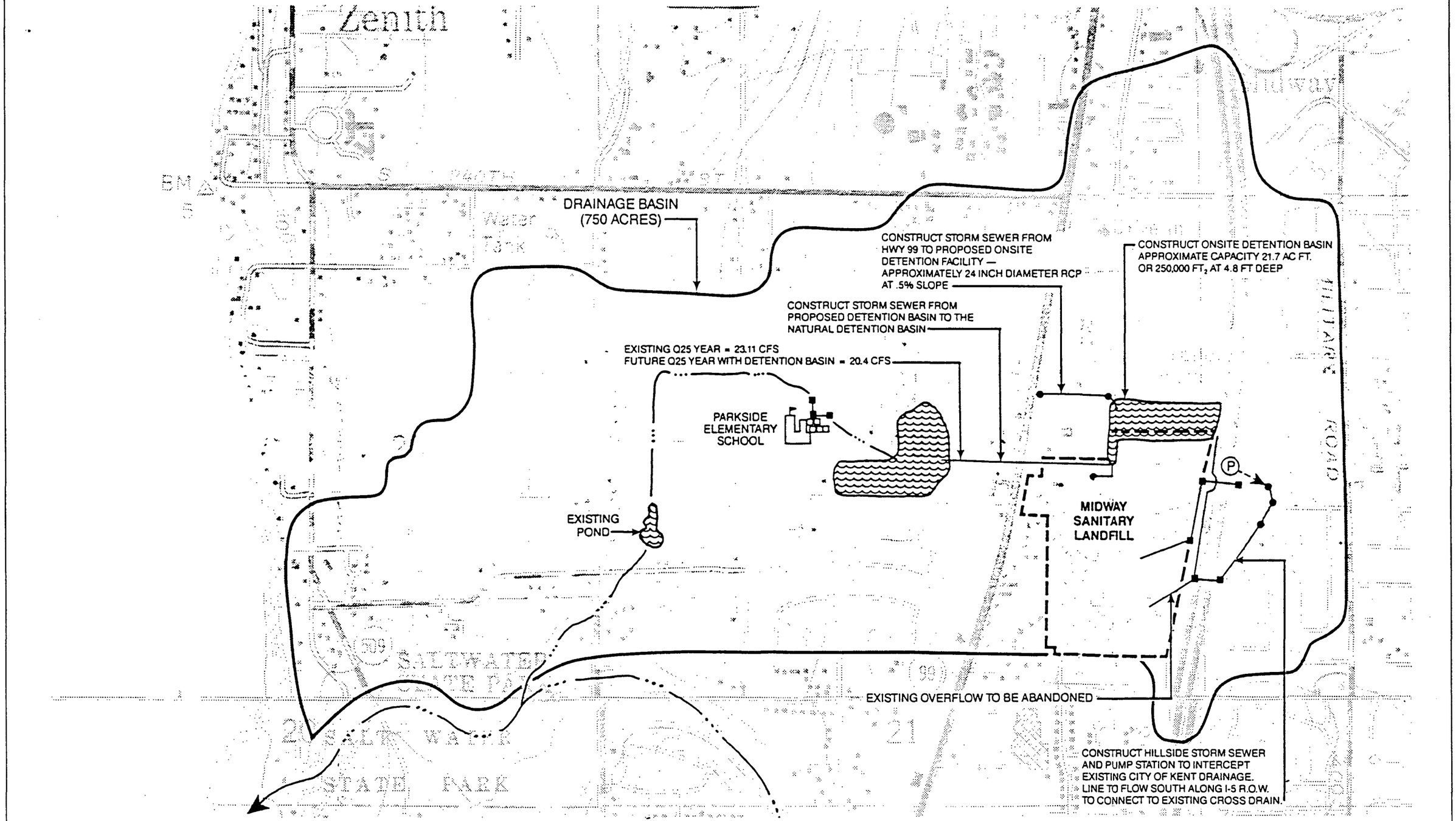


Figure 3-5. Midway Landfill drainage Puget Sound discharge alternative on-site detention basin.

3.2.3 Puget Sound Discharge Alternative With No Detention

This alternative would be similar to the Puget Sound discharge alternative with detention near Parkside Elementary School, except that no detention facilities would be provided. It would be necessary to construct a pipeline all the way from the landfill site to near the intersection of So. 250th Street and 16th Avenue South where it would discharge into an existing drainage ravine leading through Salt Water State Park and into Puget Sound. This drainage ravine is already experiencing flooding problems primarily because of flows from the southerly basin that drain into it. The increased flow from the landfill could possibly aggravate this condition, requiring improvements to the downstream drainage channel. Figure 3-6 shows a schematic representation of this alternative.

3.2.4 Green River Discharge Alternative With On-Site Detention

Discharge of surface water runoff to the Green River is technically feasible and this alternative, shown in Figure 3-7, presents a concept for achieving this by using on-site detention facilities at the Midway Landfill. With this alternative, a detention basin would be constructed at the north end of the landfill. All surface water runoff entering the landfill from the east, as well as on-site runoff, would be directed to the detention basin. At the northeast corner of the landfill a pump station with a capacity of 20 cfs (9,000 gpm) would be constructed to pump the water through a force main and gravity storm sewer northward along I-5.

The storm sewer would continue north to the Highway 516 interchange where it would be routed eastward along the highway to a point where it could be connected to the existing storm sewer on the north side of Highway 516. A possible location for this would be near the southwest corner of the Kent Highlands Landfill. This storm sewer leads to a natural drainage course that flows across the east side of the Kent Highlands Landfill and discharges in the Green River. Some improvements to the existing drainage system may be necessary to accommodate the additional flow.

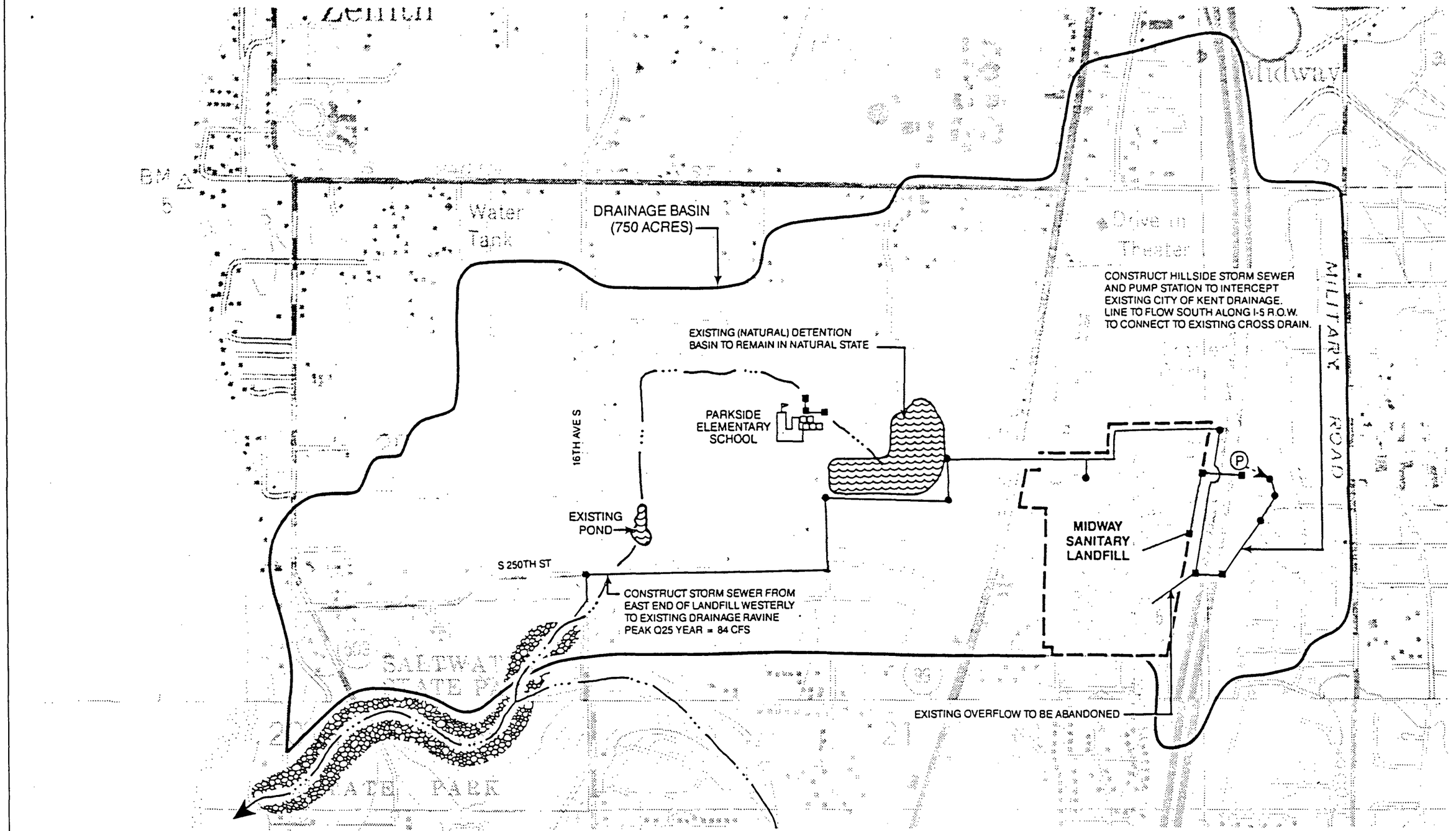


Figure 3-6. Midway Landfill drainage Puget Sound discharge alternative no detention.

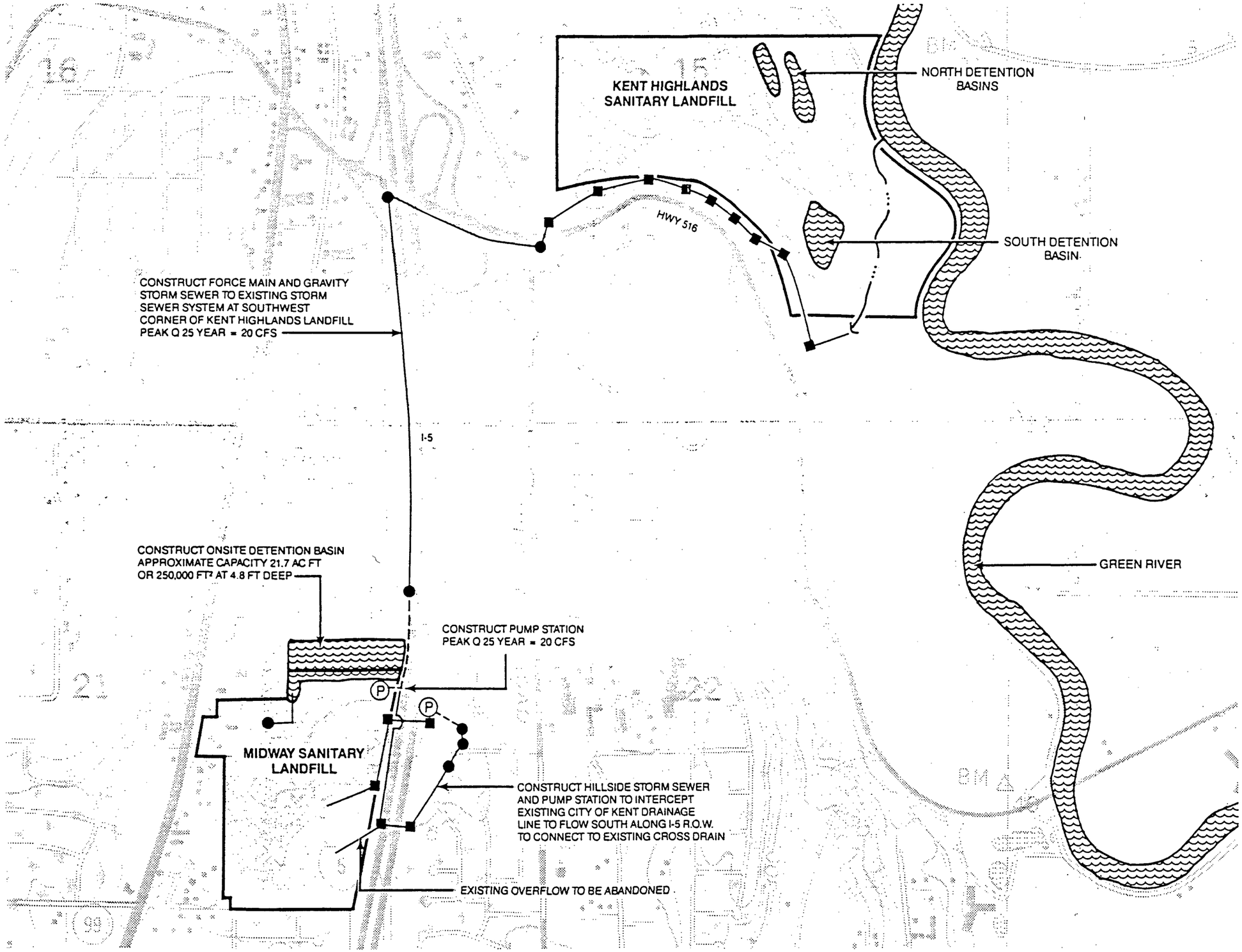


Figure 3-7. Midway Landfill drainage Green River discharge alternative on-site detention.

3.2.5 Green River Discharge Alternative With No Detention

In this alternative, surface water runoff from the Midway Landfill is discharged to the Green River, but no detention facilities would be provided. This alternative is shown in Figure 3-8. Surface water runoff from the landfill would be piped to the northeast corner of the site where it would be conveyed to the east side of I-5 through a new storm sewer constructed under the highway by jacking or boring techniques.

On the east side of the highway a pump station would be constructed for pumping the storm water to the Green River. The runoff from the tributary area east of I-5 would also be directed to the pump station through a new storm sewer system. The capacity of the pump station would need to be 69 cfs (31,000 gpm) for the 25-year storm. This would require large diameter (36 to 48-inch) pipes for the discharge force main and gravity sewer.

One possible route for the storm sewer line would be eastwards along South 248th Street to 36th Avenue South (Military Road). From there it would run north to South 244th Street where it would turn east and discharge in an existing drainage ravine. This ravine continues east under Highway 516 and then northward to where it connects to the drainage course flowing across the east side of the Kent Highlands Landfill and into the Green River. This route appears to require the least amount of piping, but the drainage course may need improvements to accommodate the increased flow.

With this alternative and the previously described Green River discharge alternative with on-site detention, there are other possible routes for conveying the water to the Green River, such as along the east side of I-5 to Highway 516 and into the existing storm sewer on the south side of the Kent Highlands Landfill. The exact routing would need to be determined by detailed engineering, environmental and economic analysis.

3.3 LEACHATE MANAGEMENT PLAN

The primary concept for leachate control at the Midway Landfill is to limit the amount of water entering the landfill. It is proposed that this be accomplished by rerouting the off-site drainage that currently enters the site from the east, as discussed under the storm water management plan alternatives, and by sealing the landfill with a low permeability cover. The features of this leachate management plan alternative are discussed below and shown in Figure 3-9.

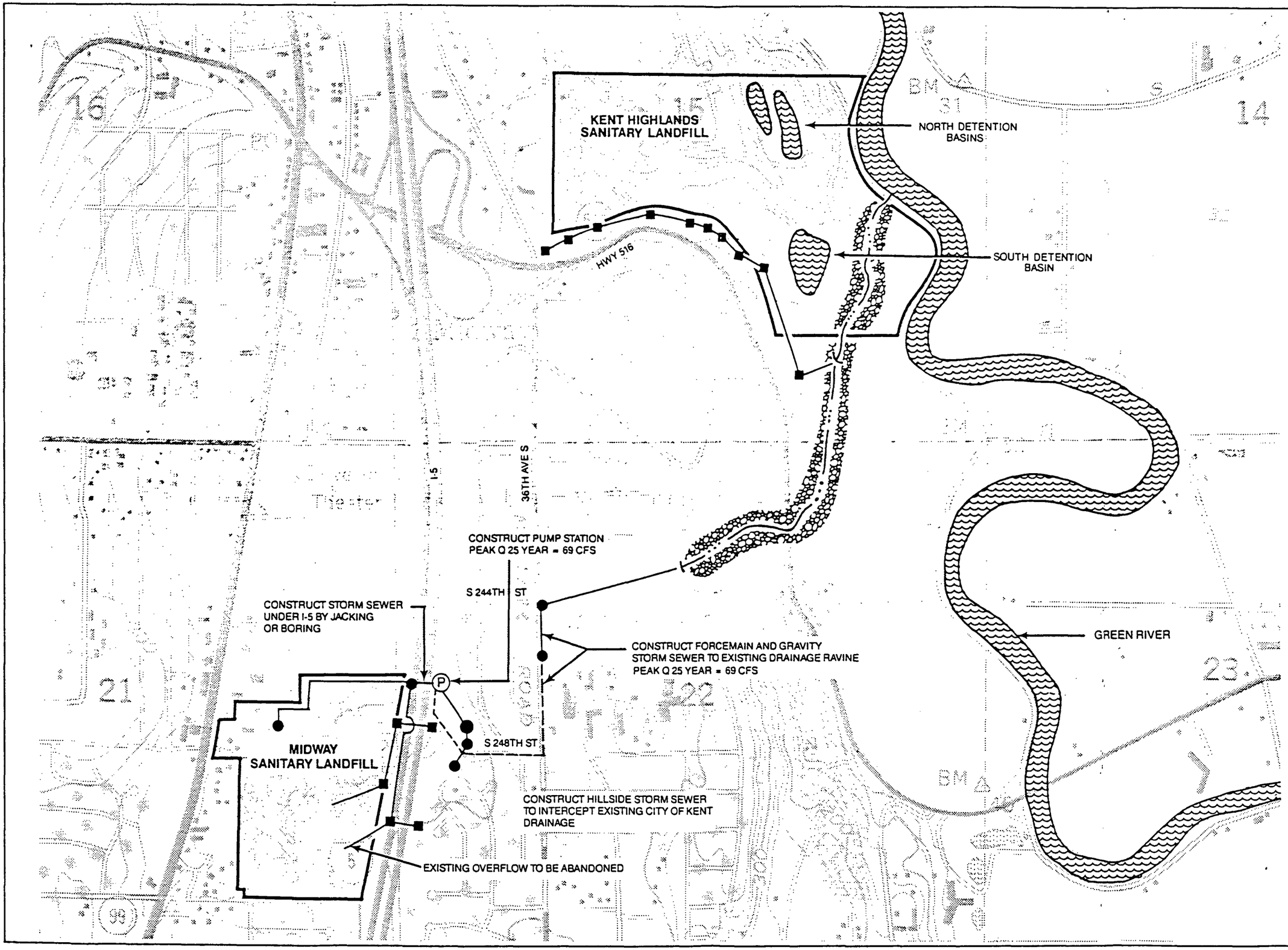


Figure 3-8. Midway Landfill drainage
Green River discharge alternative
no detention.

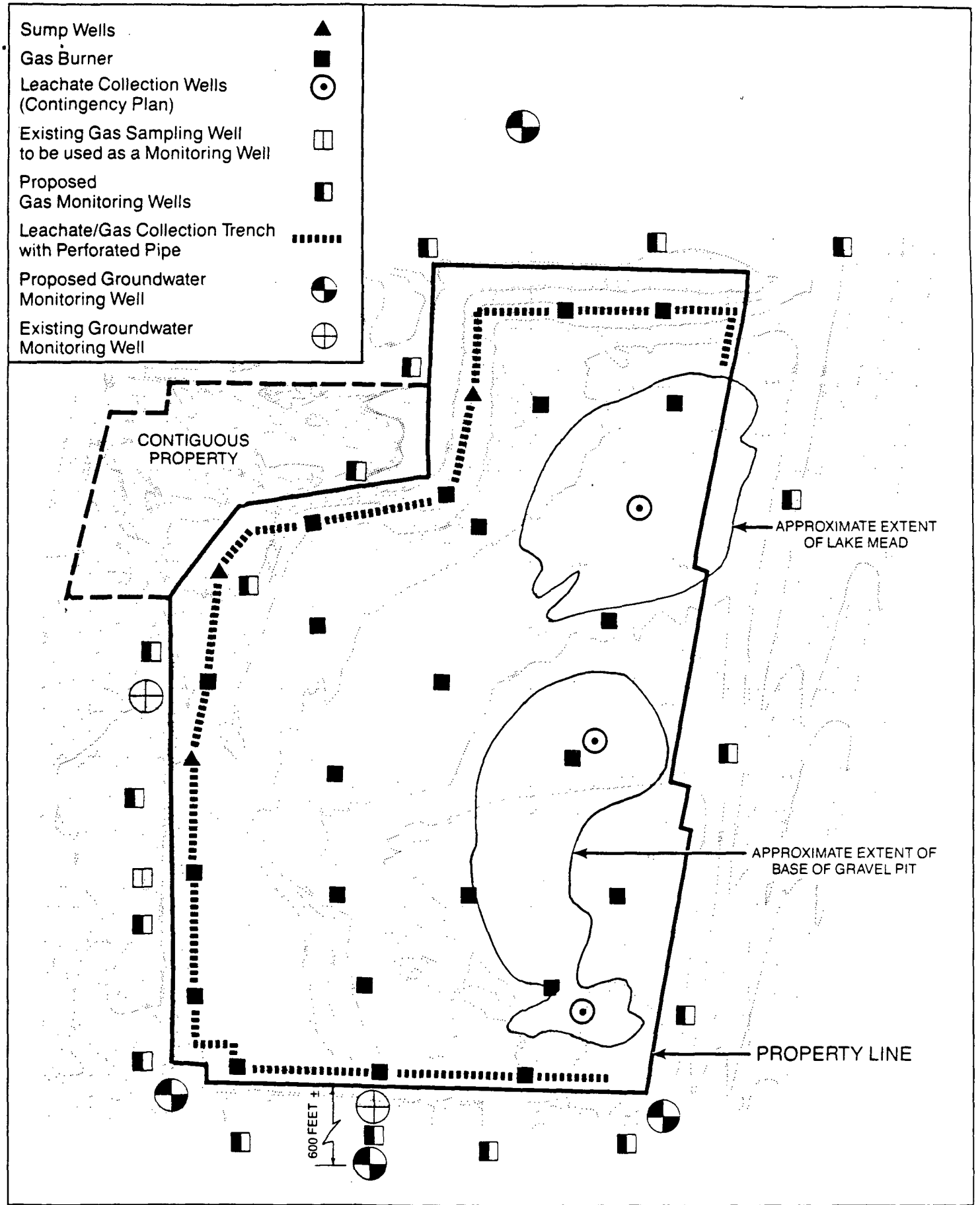


Figure 3-9. Midway Landfill leachate management and gas control plan.

3.3.1 Sealing of Landfill

Placement of a cover is intended to restrict the quantity of surface water infiltrating the landfill and thus reduce leachate production. Various artificial and natural materials can be used as a final cover; however, at Midway a soil cover system consisting of a low-permeability cover material which is overlain by topsoil and a vegetative cover should be sufficient. The low-permeability cover material should be a clayey sand to sandy silt. The compacted cover should have a maximum in-place permeability of 10^{-6} cm/sec, with values of 10^{-7} cm/sec being more desirable. The cover system for the Midway Landfill is shown in Figure 3-10.

The final soil cover should be placed after the landfill is brought up to the design grade and should be compacted. The thickness of the cover depends on the properties of the material used. Generally, the more plastic the material, the thinner the cover can be. Topsoil should be in addition to this thickness. It is estimated that 250,000 cubic yards of material will be necessary to cover the 59 acres of the landfill. The cover should be embedded at least two feet into the surrounding natural soils around the perimeter of the landfill. Potential sources for the large quantity of cover material that will be necessary are:

- Waste from the Mt. Baker tunnel excavation
- Waste from downtown Seattle building site excavations
- Material from geologically unstable areas (i.e., landslides)

Other landfill closure projects within the Northwest are utilizing this low-permeability cover cap concept. The effectiveness of this design relates directly to the ability to obtain and place natural soils with a resultant permeability of 10^{-7} cm/sec. Should natural soils of this quality not be available, soil admixtures may be used to amend natural soils. Commercially available products include natural clay minerals (sodium bentonite) and polymeric materials. If natural soil permeabilities are in the range of 10^{-4} cm/sec., soil admixtures applied at between 1 and 3 pounds per square foot, can produce the desired 10^{-7} cm/sec permeability.

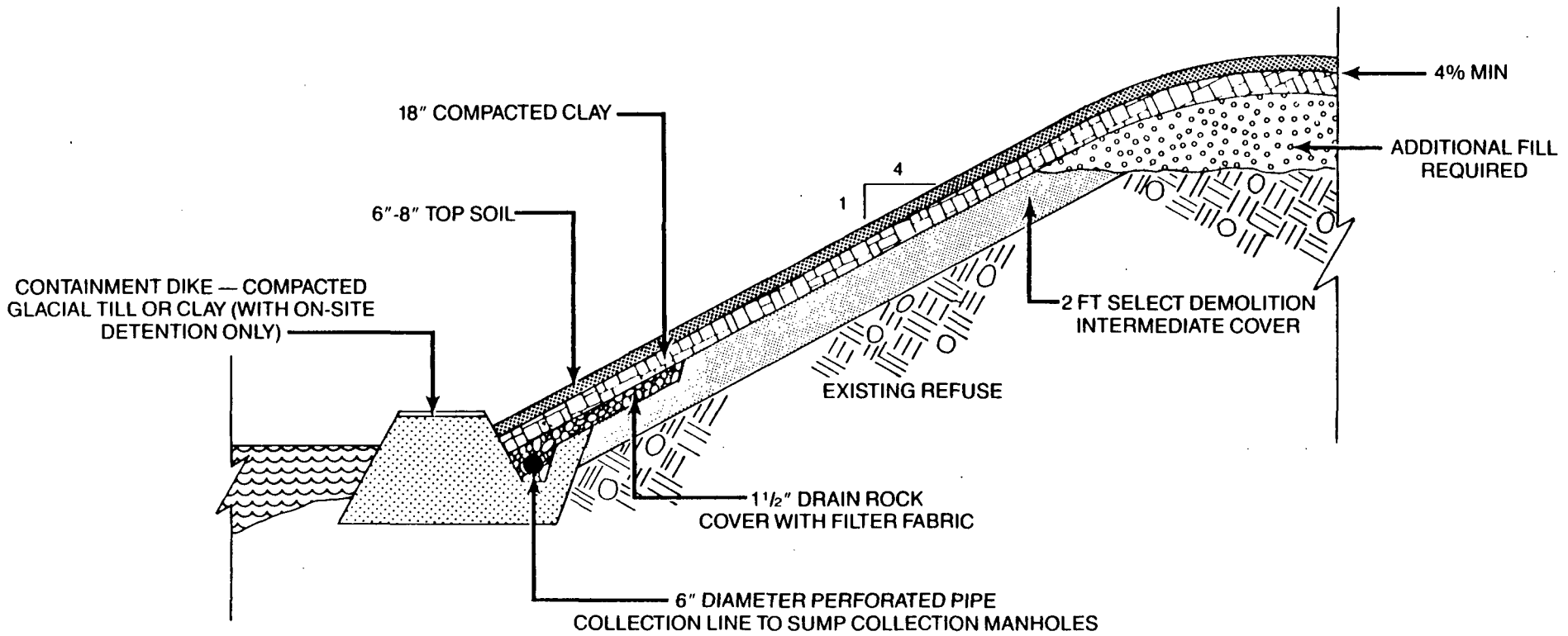


Figure 3-10. Midway Landfill typical final cover system.

The quality and depth of the topsoil cover will also effect potential leachate production. Minimum topsoil cover depths are shown assuming a cap permeability of 10^{-7} cm/sec. Should this cap permeability be somewhat lower, it will be advisable to apply additional topsoil to improve overall soil moisture holding capacities and thereby reduce potential infiltration through the cover-cap.

It is anticipated that any soil cover placed on the landfill will require periodic maintenance. This maintenance would include regrading of localized depressions and repair of cracks which would allow surface water infiltration. Maintenance would be required until the settlements have slowed or ceased.

3.3.2 Toe Seep Collection

A compacted soil cover will not provide a completely impermeable barrier to infiltration. It is estimated that the volume of annual infiltration through the cover will range from 1.5 to 14.8 acre feet, depending on the actual permeability of the final cover. Some of this infiltration will probably appear as seeps near the toe of the fill and unless collected, enter the surface water drainage facilities. Therefore, a toe seep collection system consisting of a perforated collection pipe in a gravel trench is included along the west and north toe of the fill. An impermeable containment dike will be constructed at the toe of the fill to prevent leachate breakouts. Leachate that is collected by this system would drain to a sump where it would be pumped out for disposal to an existing sanitary sewer system (Des Moines, City of Kent or Metro). Disposal could be either by piped discharge or tank truck.

3.3.3 Detection Monitoring Program

The WDOE has developed minimum functional standards for solid waste sites. The standards basically require that landfills do not pollute groundwater. The leachate management plan would include a monitoring program to detect change in off-site surface and groundwater quality so that appropriate action could be taken. The monitoring program would include two existing monitoring wells at the south and west sides of the site and four additional wells around the perimeter of the Midway site. More wells may be required in the future, depending upon the data collected from these five wells.

3.3.4 Contingency Plan

The proposed leachate management plan considers the following key elements:

- Elimination of direct surface water discharges into the landfill
- Development of a formal on-site surface water management plan
- Reduction of infiltration into the landfill through the use of a low-permeability cover cap
- Collection, treatment and disposal of nuisance seeps
- Formal detection monitoring program

Recognizing that this plan employs remedial action technology, some aspects may not totally prevent off-site migration of leachate and potential contamination of groundwater resources. Accordingly, a contingency plan must be included which can provide for corrective action should the detection monitoring program register increased degradation of groundwater quality. To propose a specific program at this point is not possible. Insufficient information is available concerning site specific, as well as regional hydrogeologic conditions.

Components of a contingency plan which might be utilized are discussed below.

On-site Collection and Pump Out. A reduction in the quantity of leachate reaching the groundwater could be accomplished by a system designed to collect a portion of the leachate. Leachate will tend to accumulate in two low areas of the landfill which were the base of the old gravel pit and Lake Mead before the filling began. Infiltration into the groundwater will be inhibited by low permeability peat and clay deposits in these areas. A series of wells placed at the top of these low permeable materials could be pumped as necessary to maintain the perched leachate levels as low as possible, thus reducing infiltration into the groundwater. Leachate pumped out would be delivered along with the leachate collected by the toe seep system to an existing sewerage treatment facility.

On-site Containment. Alternatives to contain all the leachate on the site include cut-off walls and bottom sealing. Various cut-off wall systems, which include bentonite slurry trenches, grout curtains and sheet piling, are sometimes used to divert groundwater. Usually these walls are embedded in some impervious material below the landfill. At the Midway site there is no evidence of a continuous impervious material underlying the site at a depth practical for construction of a cut-off wall. Thus, a cut-off wall probably is not a viable alternative at Midway.

Water Table Adjustment. This method considers active diversion of the groundwater system in the vicinity of the site to provide for lowering of the groundwater elevation to either prevent its contact with the wastes or reverse the flow direction to prevent down gradient migration. Both methods have proved effective at similar waste sites; however, the volumes of water handled can be significantly greater than the on-site collection and pump out scheme. No estimate of the volumes can be presented at this time. Additionally, water quality of the removed water is unknown. If the pump program is installed up-gradient of the site to simply lower the local elevations, the water quality may be high enough to allow direct discharge to an existing receiving water without treatment. If down gradient pumping is employed, there is the possibility of leachate contamination requiring treatment prior to final disposal.

Plume Containment. Should the plume of contamination be fairly localized, off-site containment may prove viable. Using a series of down gradient wells, contaminated groundwater could be removed and delivered to a recognized treatment authority for treatment and disposal.

Alternative Water Supply. The level of performance of the above alternatives may require that substitute water supplies be developed for those affected down gradient users. Examples include abandonment of existing wells and connection to an uncontaminated public supply; deepening of wells to utilize lower confined acquifers or installation of treatment facilities to provide treatment and disinfection prior to domestic use.

3.4 GAS/ODOR CONTROL PLAN

The concept for gas and odor control at the Midway Landfill includes control of any lateral gas movement from the site as well as control of gas that is moving vertically upwards in the landfill. Gas Control Alternatives for Midway Landfill are shown in Figure 3-9. In addition to the facilities discussed below, the gas/odor control plan for the Kent Highlands Landfill includes a gas monitoring program with monitoring wells spaced around the perimeter of the site.

3.4.1 Lateral Gas Movement Alternatives

Although off-site monitoring of methane has documented lateral migration of landfill gas beyond the boundary of the solid waste, very little is known at this point concerning specific mechanisms of this escape. Accordingly, the City will conduct a very detailed monitoring program this winter to better define the gas migration issues and assist in developing final control programs. The primary objective of this test program will be to locate areas of lateral migration and most importantly the depth(s) below existing ground. Additional information will include gas concentrations, pressures and soil permeabilities.

Test results forthcoming from the above described monitoring program will be utilized to establish optimum designs for lateral migration control systems. One or a combination of the following techniques could be used.

Trench Vents. The use of trench vents can be most successfully employed during actual development of the landfill where construction conditions are at an optimum around the site periphery. The trench is constructed either by excavation or utilizing waste lifts and is backfilled with high permeability gravel. This technique has been employed by the City of Seattle along the southerly boundary of the site and a separate trench is being installed along a portion of the westerly boundary. The trench is equipped with a perforated collection pipe terminating in several manhole structures around the site periphery. The structures can be utilized for both gas venting and leachate removal should the trenches become flooded.

Venting of landfill gas from the trench system can be accomplished using either a passive or active system. Under the passive system, venting is via natural pressure differentials created between gas production and atmospheric conditions. This may prove inadequate due to low withdrawal rates and adjacent soil permeabilities. In this case an active system would be utilized. This system employs an induced draft (negative pressure) system supplied by a forced air blower connected to the collection system.

Vent Wells. It may be possible to control lateral gas movement by the use of vent wells at selected locations along the perimeter of the site. To be effective, the exact areas of potential gas migration must be known so that the vent wells can be strategically placed to intercept the gas. The well consists of a perforated collection pipe surrounded by high permeability gravel. Venting can be accomplished by using either a passive or active system as described above for the trench vents.

3.4.2 Vertical Gas Movement Alternatives

For controlled venting of gas rising vertically in the landfill a layer of permeable, coarse, granular material will be placed immediately under the low permeability final cover. This would include a network of gravel filled trenches and collection pipes to conduct the gas to selected locations for removal. As with the lateral gas movement alternatives, either a passive or an active system could be used to remove gas from the landfill.

Passive System. With adequate collection trenches and properly spaced vents, a passive system can effectively remove the gas from the landfill. The success of this type of system is directly related to the design of the collection trenches and spacing of the vents. Test results from the previously discussed monitoring program will be used to establish optimum design criteria. A passive system would include burners on the vents to flare off the gas venting from the fill. The existing vents could be used by extending them as necessary to accommodate higher grades and adding additional vents as necessary.

Active System. An active system would employ mechanical pumps to create a negative pressure to remove gas from the landfill. With an active system, the gas collection system may not have to be as extensive as with a passive one, but again, without energy recovery the cost and maintenance requirements of the active system may make it unfeasible.

3.5 NO ACTION ALTERNATIVE

Because filling operations at Midway have essentially stopped, the No Action Alternative for the Midway Landfill Closure Plan would be to close the site to all material and stop all filling activity of any kind. The site would remain in its present condition with no further improvements being undertaken.

4. KENT HIGHLANDS LANDFILL EXISTING CONDITIONS

4.1 SITE DESCRIPTION

The Kent Highlands Sanitary Landfill is a 50-acre site located approximately one-half mile east of the interchange of Highways I-5 and SR-516, inside the City of Kent. The site has been operated by the Solid Waste Utility of the Seattle Engineering Department since July 1968 and is owned by Kent Highlands, Inc. The landfill site is an elongated parcel running west to east and dropping from an elevation of 300 feet to an elevation of 40 feet, respectively. Prior to landfilling operations, the site was a small ravine sloping easterly towards the Green River. The site has been operated to date according to a grading plan developed by the City shortly after operations first began. The existing site conditions are shown in Figure 4-1.

4.2 OPERATIONS STATUS

The Kent Highlands Sanitary Landfill is operated as both a putrescible and non-putrescible landfill. Filling operations are currently taking place in the south-central area. The daily operation consists of waste being hauled in trucks from the City of Kent and the City of Seattle. After unloading and compaction of the waste, soil from the area immediately north of the ravine is hauled in by scraper and used daily as cover material. After the site is brought up to approximately the proposed final grade, the surface is hydroseeded to stabilize the soil and prevent erosion.

4.3 SITE CONDITION

The entire site has been covered with fill. The filling began in the east side at the base of the ravine and has proceeded about two-thirds the way up the ravine. The lower eastern portion of the site is filled approximately to the proposed grades and filling operations in this area have stopped. The area has been benched with approximately 15 foot terraces, graded to an overall slope angle of approximately 4 horizontal to 1 vertical, and revegetated with grass. The remainder of the site ranges from about 10 to 60 feet below the proposed final grades provided by the owner's engineers.

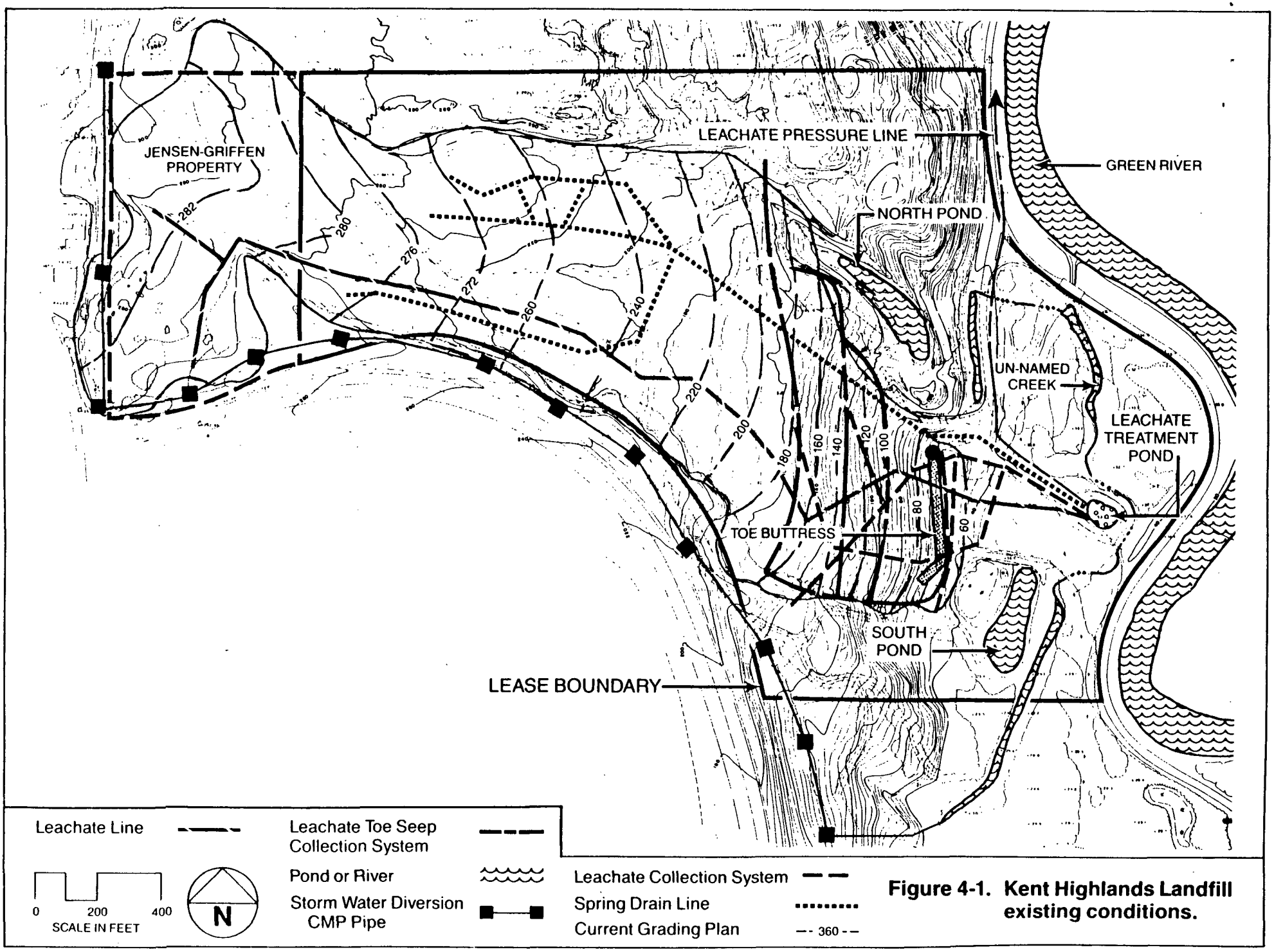


Figure 4-1. Kent Highlands Landfill existing conditions.

4.4 SURFACE WATER MANAGEMENT

The topography in the area of the Kent Highlands Landfill results in all surface water draining from west to east to the Green River. Offsite surface water originating west of the landfill is collected in a storm drainage line that routes water around the south side of the landfill to a settling pond in the valley floor adjacent to the Green River. Offsite surface water from north of the site is collected in onsite settlement ponds and eventually discharges into the Green River. Onsite surface water is conducted through various lined and unlined channels into one of three settlement ponds. From the settlement ponds it is also discharged into the Green River. Leachate contamination has been noted in the surface water ponds and drainage courses east of the leachate toe buttress. This contamination is thought to be a result of leachate migration prior to the construction of the toe buttress and settlement ponds. Leachate seeps near the surface of the landfill also may contribute to the contamination of surface water draining off of the site.

4.5 LEACHATE MANAGEMENT

During the course of the operation of Kent Highlands Landfill, various facilities were constructed to control leachate and groundwater. These facilities include an old storm water collection pipe on the south side of the landfill that is now acting as a leachate collector, a spring drain line on the north side of the landfill, a leachate collection system in the completed eastern slope of the landfill, a toe buttress and drain at the base of the completed eastern slope, and a toe seep collection system at the toe of the various landfill lifts on the eastern slope. All of these facilities drain to a leachate treatment pond at the eastern side of the site.

Investigations conducted prior to filling identified a zone of groundwater springs on the north side of the ravine near elevation 100 feet. These springs are currently being intercepted by a system of drains and conducted in a culvert to a leachate treatment pond. Groundwater/leachate within the landfill material is being collected by various leachate collection lines, generally constructed of 4 inch corrugated plastic drain pipe, located within the landfill. The exact location and condition of these lines are not known. Additional lines are placed during the filling operation to intercept and collect leachate seeps once they appear at the surface.

The primary facility for preventing leachate from entering the surface waters is the toe buttress and collection system located at the base of the fill on the east side of the landfill. The toe buttress and collection system were constructed in 1979 and consist of a sand, gravel and rubble dike constructed across the toe of the landfill. The landfill side of the buttress is lined with a PVC membrane from the top of the buttress to about 10 to 20 feet below the top, where there is a perforated plastic leachate collection pipe.

Until recently, a small pond below the toe buttress collected surface water flowing off the landfill which contained leachate. There was some indication that small quantities of leachate may have been bypassing the toe buttress collection system and also entering this small pond. These seeps were apparently a surface occurrence and did not indicate leachate flow in groundwater bypassing the toe buttress collection system. However, in the summer of 1983 a leachate toe seep collection system was installed along the toe of several of the berms on the eastern slope of the landfill. These toe seep collection facilities intercept leachate that previously was running off the landfill.

All water that is collected flows or is pumped into the leachate treatment pond. The leachate treatment pond is an aerated lagoon that provides a level of pretreatment to the leachate prior to discharge. There are also provisions to inject chemicals (hydrogen peroxide and chlorine) into the leachate for odor and corrosion control. After pretreatment in the leachate treatment pond, the leachate is pumped into Metro sewer lines for additional treatment at the Renton treatment plant and disposal.

4.6 GAS/ODOR CONTROL

Because of the type of refuse received at Kent Highlands, a significant amount of landfill gas is being generated as the waste decomposes. The City's control program for landfill gas has been to utilize ground flares connected to gravel packed, metal pipe, passive vent wells located throughout the landfill. These vents have been installed with each layer of refuse and are extended as necessary through successive layers. The gas is flared off at the vents to minimize odors.

Although there appears to be a fairly steady flow of gas from the burners and most of the gas is likely being vented in this manner, gas migration may be occurring in the medium to coarse-grained glacial drift deposits that form the upper ground layers to the north and west of the landfill. The City is planning to conduct a very detailed monitoring program this winter to better define the gas migration issues and to assist in developing final control programs.

4.7 LEASE AGREEMENT CONDITIONS

The current lease and easement agreement for the Kent Highlands Landfill between the City of Seattle (operator) and Kent Highlands, Inc. (owner) was made on September 19, 1977. The agreement contains certain terms, covenants and conditions that could possibly affect the alternative closure plans for the site. The pertinent conditions are discussed below.

4.7.1 Development and Operation of the Site

Paragraph 3 of the September 19, 1977 agreement states that the development and operation of the site "...shall be in accordance with the standards provided by Ordinance No. 1390 of the City of Kent...."

Among other things, the City of Kent Ordinance No. 1390 specifies the standards and conditions to control each sanitary landfill operation in the City. Subsection 5 of Section 4 of the ordinance states that "cover material will be withdrawn from the site itself and will consist of sandy loam or gravel. Clay will not be used as a cover material and particularly as a final cover." Subsection 17 of Section 4 states that the "final cover will be at least two feet deep."

4.7.2 Cover Material

Item d. of Paragraph 8 of the agreement states that "cover material will be withdrawn from the site itself, and will consist of sand loam or gravel. Clay will not be used as a cover material."

Item o. of Paragraph 8 states that the final cover shall be at least two feet deep.

4.7.3 City of Kent Park Site

Paragraph 9 of the agreement states that the owner has agreed to deed to the City of Kent a portion of the leased property which together with certain adjacent County land shall equal 21 acres, and the operator agrees to landscape said area. The area currently set aside for the park is located at the center of the landfill site adjacent to Highway SR-516.

4.8 JENSEN GRIFFEN PROPERTY

The west side of the Kent Highlands Landfill site is bordered by a parcel of land known as the Jensen-Griffen property. In August 1969, the City of Kent granted a Conditional Exception to allow the establishment of a sanitary landfill operation on this property subject to certain conditions. The conditions of the Conditional Exception that may be pertinent to the closure plan for the Kent Highlands Landfill are listed below.

1. That the applicants, their agents and/or assigns shall comply in all particulars with Kent City Ordinance 1071 as amended by Ordinance 1390 Subsections 1 through 17, excepting therefrom Subsection 15 and a modification of Subsection 17 to read: "When the fill is completed or abandoned, the fill must be covered with a three-foot cover."

2. That the only materials deposited shall be the same as those deposited in the City of Seattle operation adjacent to the east (Kent Highlands, Resolution #59), and is to be operated by the City of Seattle.

5. That the term of the Conditional Exception shall be for a period of three years time only, from the date of granting.

8. There will be no refuse above the ravine area and in no case above the elevation of 280 feet.

4.9 LAND USE ISSUES

The current land use designation for the Kent Highlands Landfill site is residential-agricultural (RA). The proposed land use is open space-trails for the west portion and RA for the remainder of the site.

The owners of the landfill site are currently proposing to develop the area north of the landfill site into a residential development. The area now occupied by the scalehouse is being proposed as a commercial development consisting of a hotel, conference and sport center. The residential area is to be multi-family housing with a density of approximately 32 units per acre. An EIS for the new development has recently been reviewed by the City of Kent. A change in the comprehensive plan for Kent and rezone will be required for this development.

5. KENT HIGHLANDS ALTERNATIVES

5.1 SITE GRADING PLAN

As with the Midway Landfill grading alternatives, the alternative site grading plans for the Kent Highlands Landfill include a four percent minimum slope for surface water runoff and a four horizontal to one vertical maximum fill slope for stability.

These slopes may not be compatible with the intended final land use, but the grades must be designed to permit drainage during the settlement of the fill which may be as great as 15 percent. Continual maintenance of the surface grades may be necessary during the first 5 to 10 years after closure, and some regrading may be required after the fill has stabilized to accommodate the intended final use.

5.1.1 Intermediate Grade Alternative

This alternative, shown in Figure 5-1, is intended to optimize the on-site drainage. Accordingly, the final grade of the landfill has been revised slightly with the western side of the site raised about 20 feet to improve drainage in that area. This also requires raising the grade of the adjacent Jensen-Griffen property west of the lease boundary to about elevation 300. The proposed final grades of the intermediate grade alternative reflect a center surcharge to allow for the anticipated settlements of the landfill. This alternative will require an estimated 920,000 cubic yards of material (plus final cover) to bring the site up to the final grade from its present condition. At the current rate of refuse disposal at the Kent Highlands Landfill, it is estimated that the landfill would be closed in two to three years.

The on-site drainage system included with this alternative directs surface water runoff to north and south sides of the site where open channel drainage ditches will conduct the water to on-site detention basins on the east side of the site.

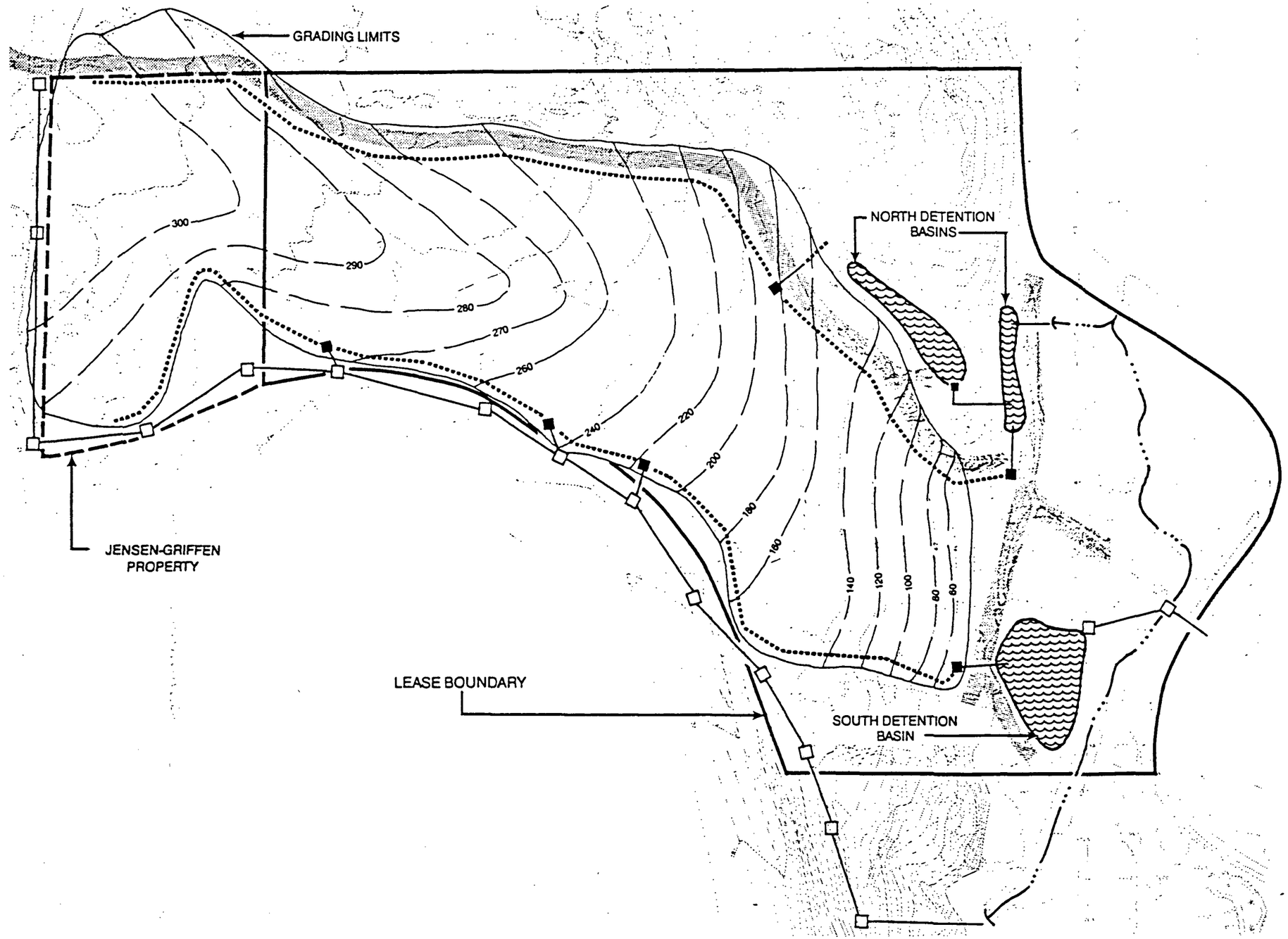


Figure 5-1. Kent Highlands Landfill intermediate grade alternative.

5.1.2 Minimum Grade Alternative

The concept of this alternative is to limit the filling on the Kent Highlands Landfill site to the same elevation established for the Jensen-Griffen property on the west side of the landfill by the City of Kent Conditional Exception for the Jensen-Griffen property. The City of Kent Conditional Exception states that there will be no refuse placed above the elevation of 280 feet. Accordingly, no grades in this alternative are above this elevation.

The minimum grade alternative is shown in Figure 5-2. The proposed final grades include a ridge at elevation 280 running eastward through the center of the site to the point where it intercepts a four to one fill slope rising from the east side of the landfill. This alternative requires an estimated 725,000 cubic yards of material (plus final cover) and would allow closure of the landfill in 1½ to 2½ years based on the current rate that refuse is being brought to the site.

For on-site drainage, this alternative directs surface water runoff away from the central ridge and to open channel drainage ditches on the north and south sides of the site, similar to the intermediate grade alternative. The drainage ditches direct the water to on-site detention basins on the east side of the site.

5.1.3 Maximum Grade Alternative

This alternative was conceived to represent the maximum amount of fill that could be placed on the site. The proposed grades included in this alternative grading plan essentially form a mound in the center of the landfill site with four to one fill slopes on all sides, as shown in Figure 5-3. This alternative would require an estimated 3,500,000 cubic yards of material (plus final cover) to bring the site to the final grades from its current condition. At the current rate of refuse disposal at the Kent Highlands Landfill, this alternative is estimated to require about seven years before the site could be closed.

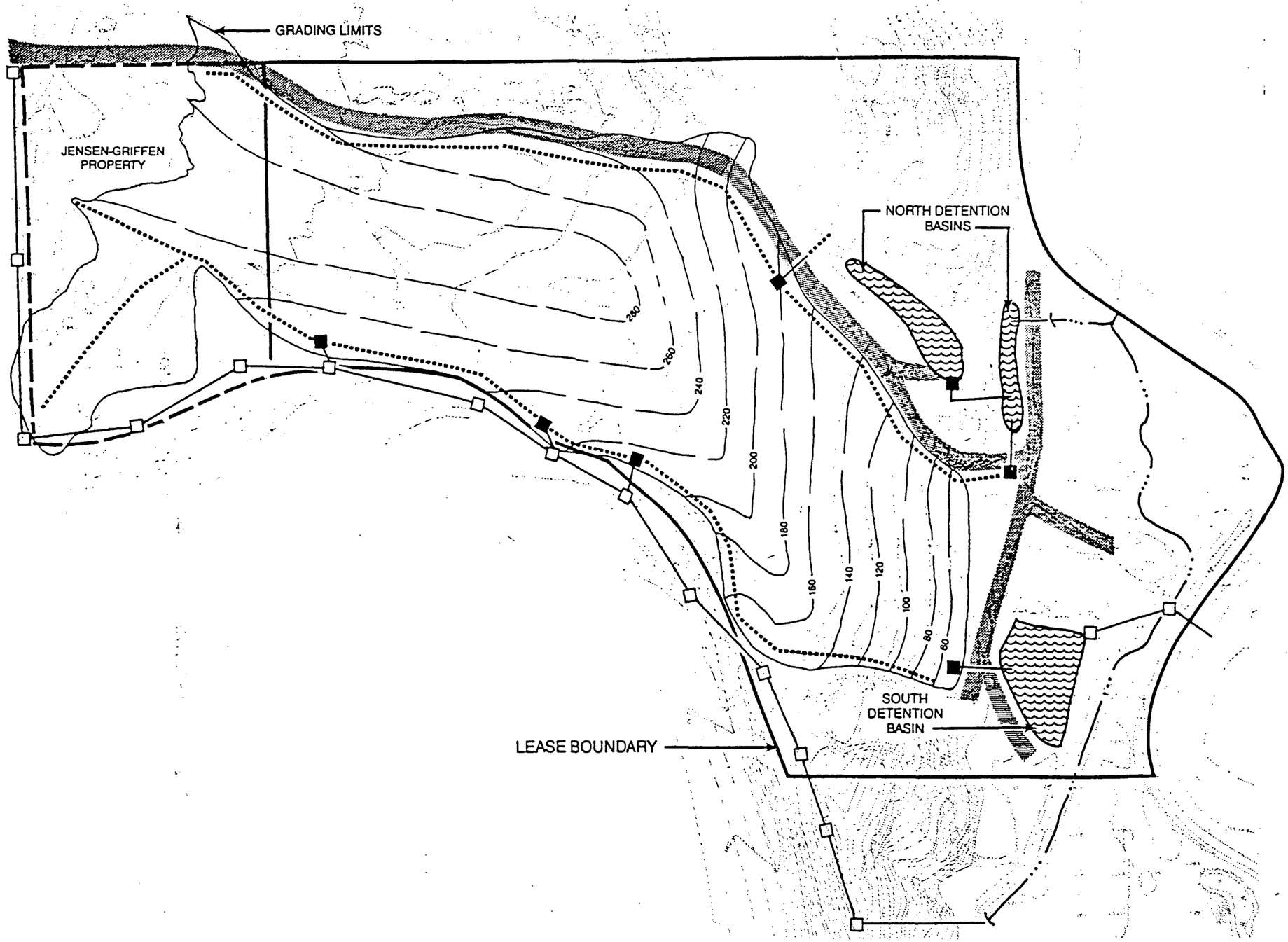


Figure 5-2. Kent Highlands Landfill minimum grade alternative.

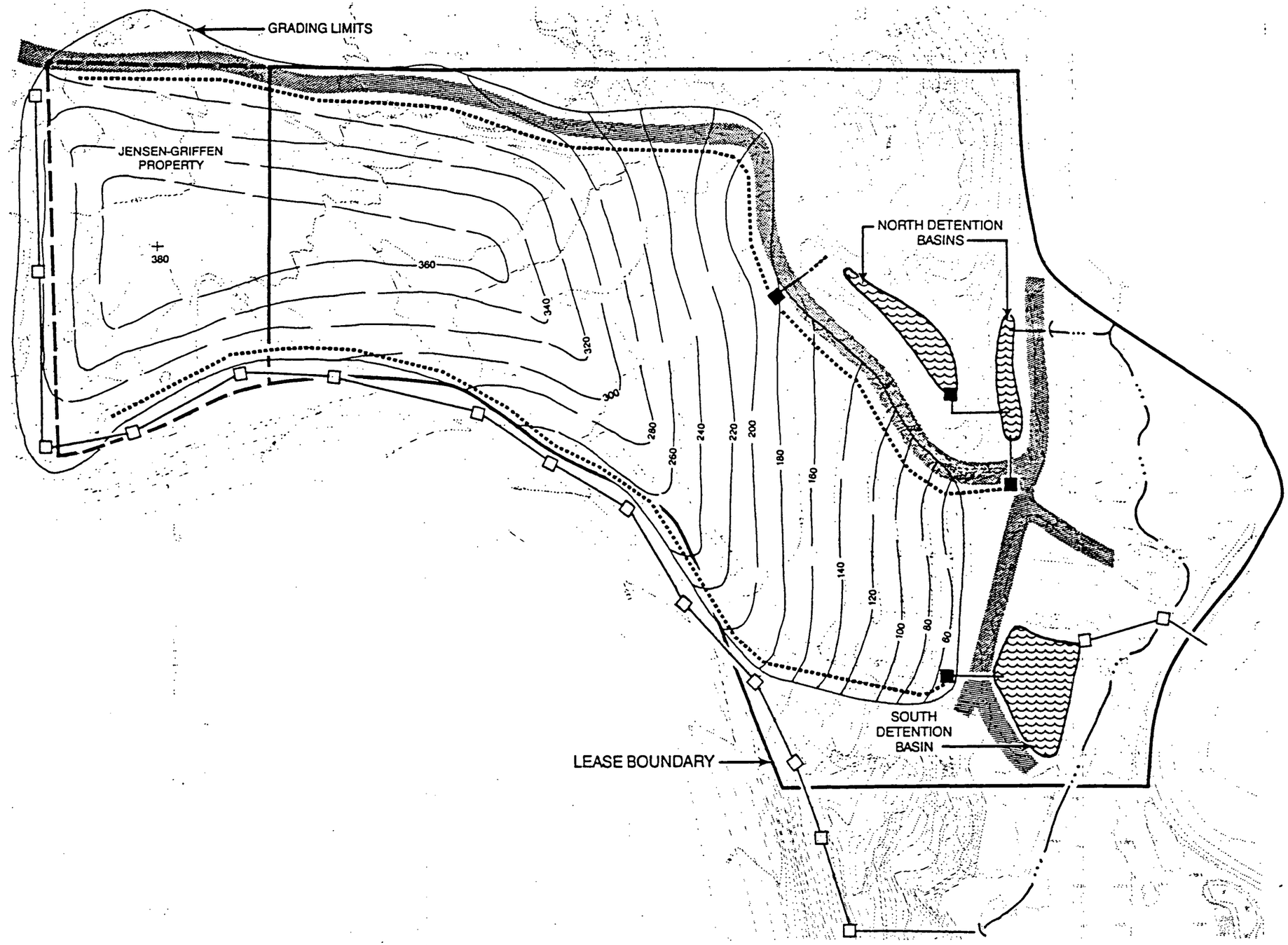


Figure 5-3. Kent Highlands Landfill maximum grade alternative.

The on-site drainage system for this alternative is similar to the other alternatives in that it directs surface water runoff to the north and south sides of the site where open channel drainage ditches will conduct it to on-site detention basins on the east side of the site. This alternative also uses drainage ditch and the existing pipe system on the west side of the site for the surface water running off the west slope of the fill. This system would convey water from the west side of the site to the drainage system on the south and eventually to the detention basins at the east side of the landfill site.

5.2 SURFACE WATER MANAGEMENT PLAN

The alternative for surface water management at Kent Highlands Landfill includes improvements to the existing facilities with on-site detention and discharge to the Green River. As with the Midway Landfill, control of the surface water runoff at Kent Highlands is one of the most important elements in the closure of the landfill and the surface water management plan is intended to be capable of handling the 25-year design storm. The site grading alternatives previously discussed describe the on-site drainage system for each alternative. Figures 5-1, 5-2 and 5-3 show the drainage facilities associated with each of the grading alternatives. In addition to the facilities discussed below, the surface water management plan includes a monitoring program to monitor all surface waters at the location where they discharge from the site.

5.2.1 Off-site Drainage Improvements

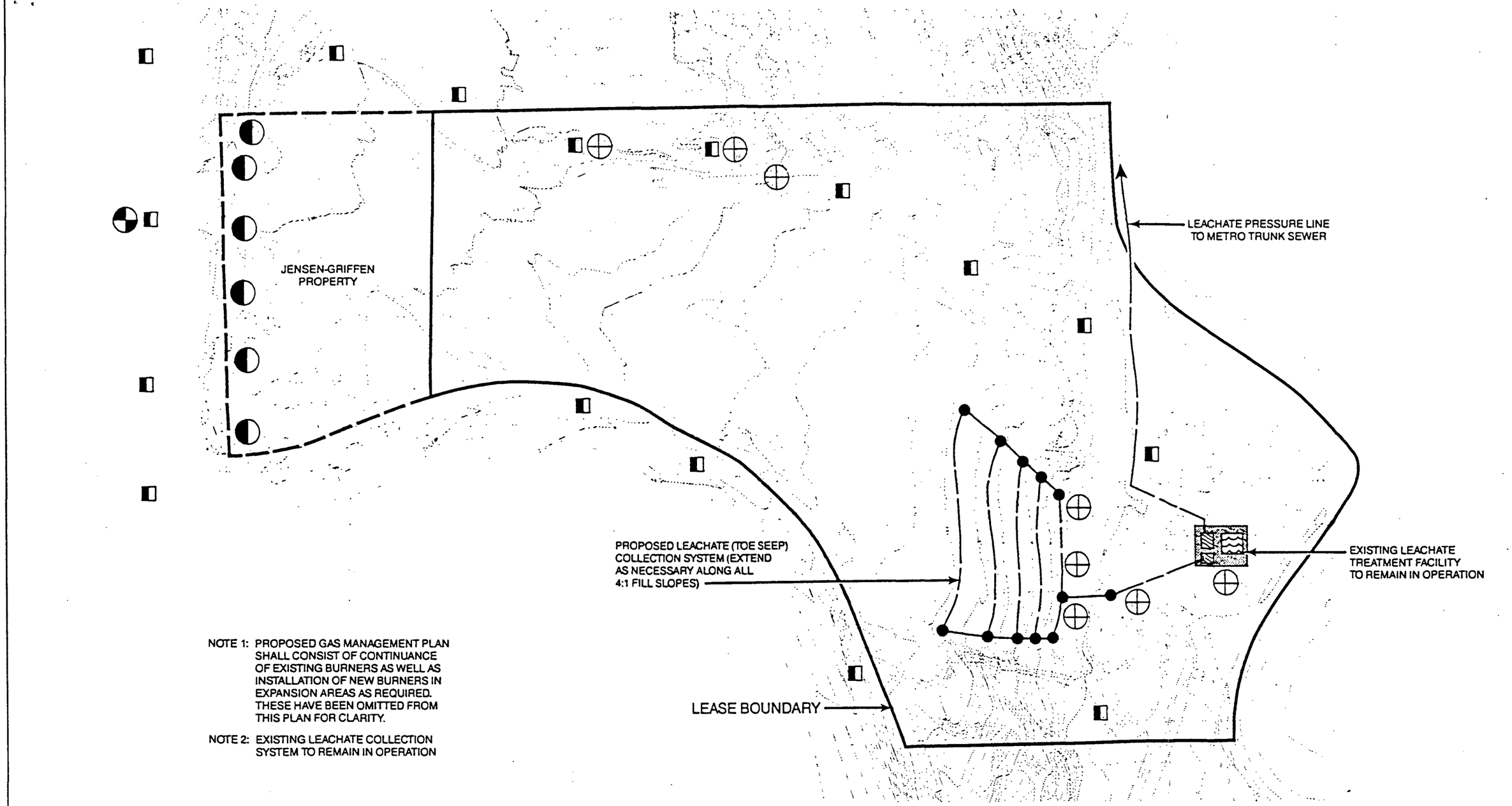
Because of the topography in the vicinity of the Kent Highlands Landfill, surface water runoff from west of the landfill is directed towards the site. This water is intercepted in roadway ditches west of the site and is conducted to a storm sewer system located on the west side and along Highway 516 on the south side of the site. With all three of the grading alternatives, a portion of the surface water runoff from the south part of the site is to be conducted to this storm sewer system also. This may require minor revisions and improvements to the system. The existing drainage system has adequate capacity for these flows and no major improvements are anticipated. This storm sewer system discharges into an existing drainage course near the southeast corner of the site and drains across the east side of the site to the Green River.

5.2.2 On-site Drainage Improvements

With the exception of the small portion of the on-site surface water runoff that goes to the storm sewer on the south side of the site, all on-site surface water runoff is conveyed to existing detention basins on the east side of the site. Some additional on-site storm sewers and ditches are included to convey all the runoff to the detention basins. The detention basins are to be cleaned and enlarged as necessary for the increased runoff. From these basins, water is discharged through a system of control structures, pipes and channels to the Green River.

5.3 LEACHATE MANAGEMENT PLAN

The alternative for leachate management at Kent Highlands is somewhat dictated by the established pattern of leachate control facilities. These facilities are currently installed and are effectively intercepting and treating leachate prior to discharge to the Metro sewer system. The alternative closure plan elements will not reduce the viability of the current leachate management plan. The stormwater management alternative is intended to reduce surface water infiltration into the landfill, and to further reduce infiltration the concept for leachate control at Kent Highlands includes sealing of the landfill. In addition, a leachate toe seep collection system to collect any seeps occurring along the fill slopes is included. In order to ascertain any off-site migration of leachate, a detection monitoring program is proposed as part of the leachate control alternative, and furthermore, should off-site migration be detected, elements of a contingency plan that is included in the leachate control alternative could be implemented. The leachate control facilities for the Kent Highlands Landfill are shown in Figure 5-4.



NOTE 1: PROPOSED GAS MANAGEMENT PLAN SHALL CONSIST OF CONTINUANCE OF EXISTING BURNERS AS WELL AS INSTALLATION OF NEW BURNERS IN EXPANSION AREAS AS REQUIRED. THESE HAVE BEEN OMITTED FROM THIS PLAN FOR CLARITY.

NOTE 2: EXISTING LEACHATE COLLECTION SYSTEM TO REMAIN IN OPERATION

0 150 300
SCALE IN FEET

N

Proposed Groundwater Monitoring Wells

Existing Groundwater Monitoring Wells

Deep Methane Gas Collection Wells

Proposed Gas Monitoring Wells

Figure 5-4. Kent Highlands Landfill leachate management and gas control plan.

5.3.1 Sealing of Landfill

Placement of a cover is intended to restrict the quantity of surface water infiltrating the landfill and thus reduce leachate production. Various artificial and natural materials can be used as a final cover; however, at Kent Highlands a soil cover system consisting of a low-permeability cover material which is overlain by topsoil and a vegetative cover should be sufficient. The cover system is shown in Figure 5-5. The low-permeability cover material should be a clayey sand to sandy silt. The compacted cover should have a maximum in-place permeability of 10^{-6} cm/sec, with values of 10^{-7} cm/sec being more desirable. This is the same cover system as proposed by the Midway Landfill site. It is estimated that 350,000 cubic yards of material will be necessary to cover the Kent Highlands Landfill. Potential sources for this material are the same as those listed for the Midway Landfill. The material from the abandoned sand and gravel operation located just north of the Kent Highlands site may be suitable as a final cover if it is amended with silt or clay.

5.3.2 Toe Seep Collection

The existing leachate collection system is to remain in operation. In addition, a new toe seep collection system, as shown in Figure 5-4, is proposed to collect leachate toe seeps along the face of all fills placed at four to one slopes. With the intermediate and minimum grade alternatives, this would be only on the east face of the fill. (Several of these toe seep collection lines were installed on the existing slope during the summer of 1983.) With the maximum grade alternative, a toe seep collection system would be required on all four faces of the fill. These collection systems would be connected to leachate interceptors on the north and south sides of the site that would convey leachate to the existing treatment facility. Treated leachate would be pumped through pipes to the Metro interceptor system for further treatment and discharge.

5.3.3 Detection Monitoring Program

The leachate management plan for Kent Highlands includes a monitoring program to detect any change in off-site surface and groundwater quality so that appropriate action could be taken. The monitoring program includes five existing monitoring wells at the east side of the site, three existing wells on the north side of the site, and one additional well west of the Kent Highlands site. More wells may be required in the future, depending upon the data collected from these wells.

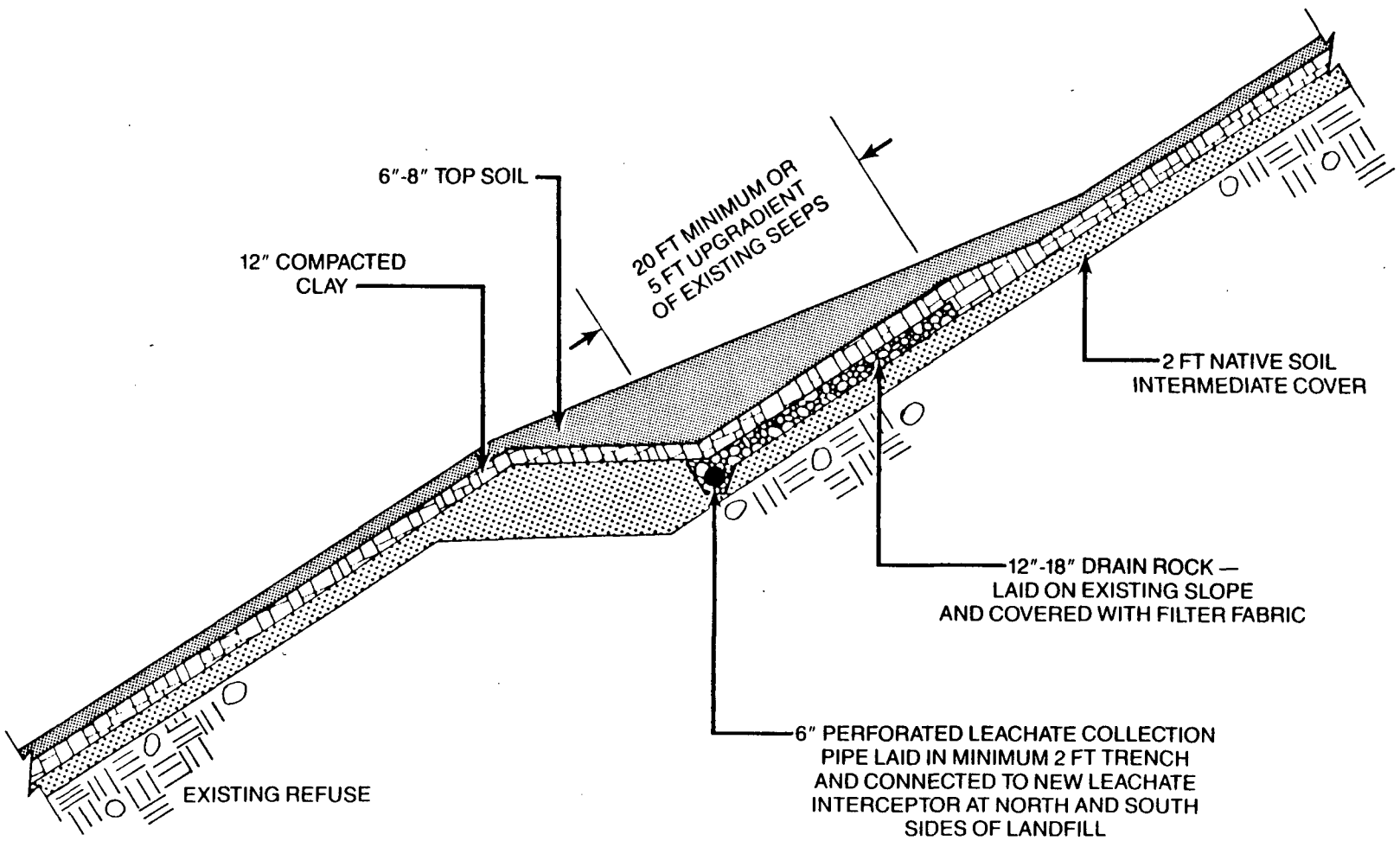


Figure 5-5. Kent Highlands Landfill typical final cover system.

5.3.4 Contingency Plan

A contingency plan for the Kent Highlands Landfill leachate control alternative is included to provide for corrective action that might be required should the detection monitoring program register increased degradation of groundwater quality. As with the Midway Landfill site, insufficient information is available for the Kent Highlands site, as well as regional hydrogeologic conditions, so that a specific program is not possible at this time. Components of a contingency plan which might be utilized for Kent Highlands are the same as those discussed for the Midway site, but some may be more or less feasible at Kent Highlands than at Midway.

5.4 GAS/ODOR CONTROL PLAN

The concept for gas and odor control at the Kent Highlands Landfill includes control of any lateral gas movement from the site, as well as control of gas that is moving vertically upwards in the landfill. Gas Control Alternatives for Kent Highlands Landfill are shown in Figure 5-4. In addition to the facilities discussed below, the gas/odor control plan for the Kent Highlands Landfill includes a gas monitoring program with monitoring wells spaced around the perimeter of the site.

5.4.1 Lateral Gas Movement Alternatives

Although off-site lateral migration of landfill gas beyond the boundary of the solid waste is suspected, very little is known at this point concerning specific mechanisms of this escape. Accordingly, the City will conduct a very detailed monitoring program this winter to better define the gas migration issues and assist in developing final control programs. The primary objective of this test program will be to locate areas of lateral migration and most importantly the depth(s) below existing ground. Additional information will include gas concentrations, pressures and soil permeabilities.

Test results forthcoming from the above described monitoring program will be utilized to establish optimum designs for lateral migration control systems. One or a combination of the following techniques could be used.

Deep Gas Collection Wells. For control of deep methane gas migration west of the landfill, a series of deep gas collection wells could be constructed within the permeable deposits in which the gas is migrating. Depending on the size and depths of these wells, either a passive or an active gas collection system could be utilized.

Trench Vents. Shallow gas migration could be controlled by a trench vent system. This technique has been employed by the City at the Midway Landfill for control of shallow gas migration. The trench is equipped with a perforated collection pipe terminating in several manhole structures around the site periphery. The structures can be utilized for both gas venting and leachate removal should the trenches become flooded. Venting could be accomplished by either a passive or an active system.

Vent Wells. Shallow vent wells could also be used to control shallow migration of landfill gas. These wells would be similar to those described for the Midway Landfill and could use either a passive or an active system to vent the gas, depending on design and spacing of the wells.

5.4.2 Vertical Gas Movement Alternatives

For controlled venting of gas rising vertically in the landfill a layer of permeable, coarse, granular material will be placed immediately under the low-permeability final cover. This would include a network of gravel filled trenches and collection pipes to conduct the gas to selected locations for removal. As with the lateral gas movement alternatives, either a passive or an active system could be used to remove gas from the landfill.

Passive System. With adequate collection trenches and properly spaced vents, a passive system can effectively remove the gas from the landfill. A passive system would include burners on the vents to flare off the gas venting from the fill. The existing vents could be used by extending them as necessary to accommodate higher grades and adding additional vents as necessary.

Active System. An active system would employ mechanical pumps to create a negative pressure to remove gas from the landfill. With an active system, the gas collection system may not have to be as extensive as with a passive one, but again, without energy recovery the cost and maintenance requirements of the active system may make it unfeasible.

5.5 NO ACTION ALTERNATIVE

The no action alternative for the Kent Highlands Landfill Closure Plan would be to continue filling the site, as is currently being done, in accordance with the current grading plan. When the site is filled to these grades, filling would stop and the site would be covered with two feet of final cover material consisting of sand loam or gravel, in accordance with the lease agreement. All other aspects of the landfilling operation would continue as they currently are until the site is filled.